



Lusail Smart City Guidelines

Version 4.0

17/06/2015

TABLE OF CONTENTS

CONTRIBUTORS:	4
1. CHRISTOPHER EBENEZER	4
2. SAMER SAID	4
1 DEFINITIONS	5
2 OBJECTIVE	6
3 TARGET AUDIENCE	6
4 DISCLAIMER	6
5 LUSAIL ACCESS NETWORK INFRASTRUCTURE REQUIREMENTS FROM LANDSCAPE DEVELOPERS	7
5.1. LUSAIL SMART CITY CIVIL NETWORK.....	7
6 GUIDELINES FOR BUILDING DESIGNERS	9
6.1. GENERAL CONFORMANCE FOR ALL BUILDING STRUCTURES.....	9
6.1.1. <i>Containments</i>	9
6.1.1.1. Specifications.....	9
6.1.1.2. General Requirements.....	10
6.1.2. <i>Cables</i>	10
6.1.2.1. Specifications.....	10
6.1.2.2. General Requirements.....	10
6.2. RESIDENTIAL STRUCTURES.....	11
6.2.1. <i>Multi Dwelling Unit Building</i>	11
6.2.1.1. Containment Requirements.....	11
6.2.1.2. Cabling Requirements.....	12
6.2.1.3. Scope of Responsibility.....	12
6.2.2. <i>Single Villa with One Floor / Multiple Floors</i>	13
6.2.2.1. Containment Requirements.....	14
6.2.2.2. Cabling Requirements.....	14
6.2.2.3. Scope of Responsibility.....	14
6.3. COMMERCIAL / RETAIL (SHOPPING MALL).....	15
6.3.1. <i>Containment Requirements</i>	15
6.3.2. <i>Cabling Requirements</i>	16
6.3.3. <i>Scope of Responsibility</i>	16
6.4. MIXED USE (RESIDENTIAL & COMMERCIAL) BUILDING.....	17
6.4.1. <i>Containment Requirements</i>	17
6.4.2. <i>Cabling Requirements</i>	18
6.4.3. <i>Scope of Responsibility</i>	18
6.5. HOTELS.....	19
6.5.1. <i>Containment Requirements</i>	19
6.5.2. <i>Cabling Requirements</i>	20
6.5.3. <i>Scope of Responsibility</i>	20
6.6. HOSPITAL / MEDICAL CENTRE.....	21
6.6.1. <i>Containment Requirements</i>	21
6.6.2. <i>Cabling Requirements</i>	22
6.6.3. <i>Scope of Responsibility</i>	22
6.7. OFFICE BUILDING.....	23
6.7.1. <i>Containment Requirements</i>	23
6.7.2. <i>Cabling Requirements</i>	24
6.7.3. <i>Scope of Responsibility</i>	24

6.8.	INSTITUTIONAL / SCHOOLS	25
6.8.1.	Containment Requirements	25
6.8.2.	Cabling Requirements.....	26
6.8.3.	Scope of Responsibility	26
6.9.	EXHIBITION CENTRES / CONVENTION CENTRES / MULTIPURPOSE HALLS	27
6.9.1.	Containment Requirements	27
6.9.2.	Cabling Requirements.....	28
6.9.3.	Scope of Responsibility	28
6.10.	UTILITY BUILDINGS (SUBSTATIONS/DISTRICT COOLING PLANTS/PUMP STATION)	29
6.10.1.	Containment Requirements	29
6.10.2.	Cabling Requirements.....	30
6.10.3.	Scope of Responsibility	30
6.11.	CAR PARKS	31
6.11.1.	Containment Requirements	31
6.11.2.	Cabling Requirements.....	32
6.11.3.	Scope of Responsibility	32
7	INTERFACING REQUIREMENTS	33
7.1.1.	Scenario 1 : Native IP Devices.....	33
7.1.2.	Scenario 2 : Network Interface Unit (NIU).....	34
7.1.3.	Scenario 3 : Layer 1 & Layer 2 Devices.....	34
7.1.4.	Scenario 4 : Smart Service Specific Core Apparatus.....	34
8	DESIGN APPROVAL PROCESS.....	34
9	APPENDIX 1: SAMPLE CALCULATIONS (ACTUAL SCENARIO MAY VARY).....	36
9.1.	EXAMPLE 1: TEN FLOORS MULTI DWELLING BUILDING	36
9.1.1.	Example Details	36
9.1.2.	Cables Calculations.....	37
9.1.3.	Duct Calculations.....	37
9.2.	EXAMPLE 2: SINGLE DWELLING (TWO FLOOR VILLA) BUILDING	39
9.2.1.	Example Details	39
9.2.2.	Cables Calculations.....	40
9.2.3.	Duct Calculations.....	40

TABLE OF FIGURES

Figure 1 - Duct No. 54D Duct dimensions	7
Figure 2 - Duct No. 56D Duct dimensions	8
Figure 3 - Duct with tapered socket end	8
Figure 4 – Lusail Duct Network Depth in the cases of (a) single duct (b) Duct bank (c) Duct bank with Concrete surround	9
Figure 5 - Multi Dwelling Unit Building	11
Figure 6 – Single Villa with One Floor.....	13
Figure 7 – Single Villa with Multiple Floors	13
Figure 8 - Commercial / Retail (Shopping Mall).....	15
Figure 9 - Mixed Use (Residential & Commercial) Building	17
Figure 10 – Hotels	19
Figure 11 - Hospital / Medical Centre	21
Figure 12 - Office Building.....	23
Figure 13 - Institutional / Schools	25
Figure 14 - Exhibition Centres / Convention Centres / Multipurpose Halls	27
Figure 15 - Utility Buildings (Substations/District Cooling Plants / Pump Station).....	29
Figure 16 - Car parks	31
Figure 17 – Interfacing scenarios of Smart devices with LCCC	33
Figure 18 - Building Permit Approval process of Lusail City Administrative Complex (CAC).....	35
Figure 19 - Example 1: Ten Floor Multi Dwelling Building Illustration	36
Figure 20 - Example 1: Floor Aggregation Point (FAP) room cross section (Top View)	39
Figure 21 - Example 2: Single Dwelling (Two Floor Villa) Building	40

Lusail Smart City Guidelines

Version 4.0

Document Control

Document Title	Lusail Smart City Guidelines
Release Date	17 June 2015
Document Reference	NLOB-TG-v4.0-LUS-008
Department	NLOB
Classification Policy	Confidential

Version Control

Version	Date	Reviewed By	Approved By	Modifications Done
1.0	24 th Mar, 14	Karam Al-Shorbassi	Wael Doukma	Initial Release
2.0	18 th May, 14	Karam Al-Shorbassi	Wael Doukma	- Section 8 has been revised and updated. - Appendix 2 has been added.
3.0	17 th June, 14	Karam Al-Shorbassi	Wael Doukma	- Section 6.6 has been updated. - Section 8 has been updated. - Previous Sections 10 & 11 under Version 2.0 has been merged under new Section 10. - In Section 11 & 12 subsection numbering has been updated.
4.0	20 th May 15	Shah Afghan		-Section 5,6 and 11 has been removed - Naming convention changes: LIAN to LAN (Lusail Access Network) - Fiber to Fibre - Center to Centre

Contributors:

1. Christopher Ebenezer
2. Samer Said

1 Definitions

“**Lusail Access Network**” means all the fibre contained in the company infrastructure relating to the **Telecommunications Apparatus** and the **ICTE Apparatus** required to carry **Telecommunication Services** and/or **ICTE Services** from Telecommunications Apparatus and/or ICTE Apparatus and/or **End-User(s)**;

“**Building**” means any structure consisting of apartments(s) / shop(s) built for the purpose to host residents or business including villas, low rise buildings, medium rise buildings, high rise buildings and shopping malls. It does not include schools, hospitals, or any type of special purpose structures such as car parks or utility plants.

“**Containment**” means those aspects of the **Building** relating to or associated with carrying cables used in the provision of Telecommunication Services and Smart Services and shall include but shall not be limited to all or any part of pipe, conduit, cable duct, trough, tube, channel, cable tray, trunking or riser.

“**Core Apparatus**” means software and hardware such as routers, switches, repeaters, software, servers and other necessary hardware that will be required for the operation of **Smart Services** with Lusail Smart City.

“**Design Consultants**” means party or parties that are involved in technical design of services within the building structures which form part of their project developments.

“**Developer**” means any person(s) involved in the process of building a **Building**.

“**Field Apparatus**” refers to the software and the hardware that are required to enable provision of smart services within Lusail Smart City.

“**Lusail Command and Control Centre (LCCC)**” means a control tower which integrates, manages, maintains and monitors **Smart Services** and relevant systems based on diverse interface standards. It will be designed considering the efficiency of service operation and smooth monitoring of various services;

“**Network Interface Unit (NIU)**” means the apparatus employed to aggregate/protocol conversion or both if required and there by transmitting safe/reliable bi-directional data from/to any of the system modules employed in the Lusail smart services system architecture;

“**Service Point**” means any location within a Structure including Residential apartments, Villas, Offices, Institutions, Schools, Hotels, Hospitals, Shopping malls, Exhibition Centres, Convention Centres, Multipurpose Halls, Utility Buildings, Car parks where smart service may be required. Examples of Service Points are CCTV Camera, Access Card Reader, Security Door Actuator, Energy Meters (Electricity, Water, Gas and District Cooling), Elevator Control Panel, Light Control Panel, Air Condition Control Panel, Fire Control Panel, etc...

“**Stakeholder**” refers to the third party organization who shares their business interests in the Lusail smart city project;

“**Utility Room**” refers to each room designed to host equipment of specific service (CCTV, District Cooling, BMS, PWC, etc...) that is part of smart city services.

2 Objective

The purpose of “Lusail Smart City Guidelines” is to give design consultants a list of considerations that are to be completed during the design and construction of their relevant project developments within Lusail Smart City.

It is mandatory that all design consultants conform to the “Lusail Smart City Guidelines”, to ensure Smart Service compatibility and capability for their relevant project development within Lusail Smart City, during the building permit application process.

“Lusail Smart City Guidelines” is compliant to version 6.0 of “Internal Cabling Guidelines” published by ICT Qatar on February 28th, 2013.

For full understanding of this document, design consultants shall refer to the “Internal Cabling Guidelines” v6.0 published by ICT Qatar on February 28th, 2013, available at Ooredoo web site at the below link.

http://www.ooredoo.qa/idc/groups/public/documents/document/internal_cabling_guidelines_en.pdf.

3 Target Audience

This document is intended for use by Design consultants involved in design of services in project developments within Lusail Smart City. The scope of project developments includes all types of building structures construction.

The design consultants is obligated to co-ordinate with the Smart Service Provider, Ooredoo during the preliminary design and detailed design stages. The interaction period is defined based on the type of project development within Lusail Smart City.

4 Disclaimer

The information provided in this document is to help design consultants to accommodate the containments and cabling requirements for smart services into their project development designs. It shall not be considered as a design document.

The information detailed in this document is not to be considered as a work instruction. The information provided is to assist design consultants understand the type and nature of containment requirement for smart services in their project developments within Lusail Smart City.

The information provided in the document is to help the design consultants and implementation engineers understand the type and nature of interfacing requirements for the smart services with LCCC.

The classification of various interfacing scenarios in the document is based on Ooredoo’s understanding on the Lusail Smart City project and is generalized to cover all/most of the smart services proposed.

This document specifies the interface specification for smart services to be implemented in Lusail Smart City.

5 Lusail Access Network Infrastructure Requirements from Landscape Developers

5.1. Lusail Smart City Civil Network

Lusail Smart City employs a wide network of underground ducts which enable the deployment of Smart City Services operator’s networks or the connection of any smart service device to the Operator’s network using fibre throughout Lusail Smart City.

The Lusail Access Network provides connection of each and every villa, apartment, building, controller, and any other type of field apparatus. Interfacing of smart devices across a wide range of scenarios are provided by LAN acting as the backbone of the Lusail Smart City operations.

In Lusail Smart City, the underground ducts and cable chambers which enable the deployment of the Lusail Access Network, are designed to meet the needs for future advanced smart services in an efficient, safe, harmonised and cost effective way, while avoiding further repetitive or remedial civil works. It provides an optimum routing for cables within the Lusail Smart city environment while providing good protection and work party access.

The duct bank size is related to the amount of cable to be placed within the duct bank and the properties of the specified cable.

The Lusail Smart City duct network utilizes primarily the following two types of ducts:

- Duct No. 54D

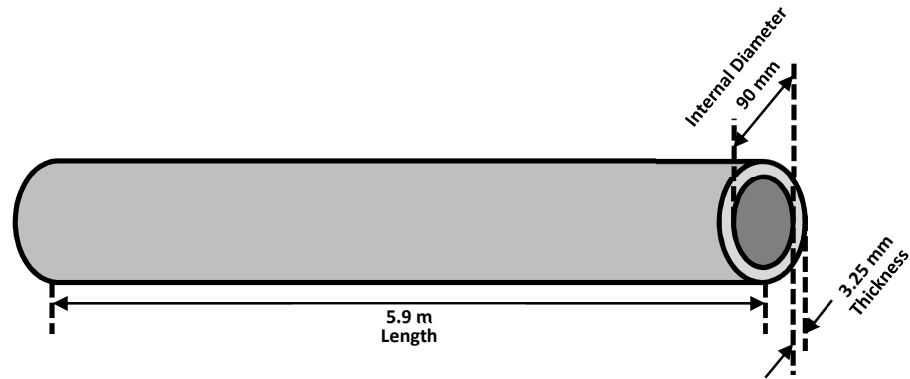


Figure 1 - Duct No. 54D Duct dimensions

- Duct No. 56D

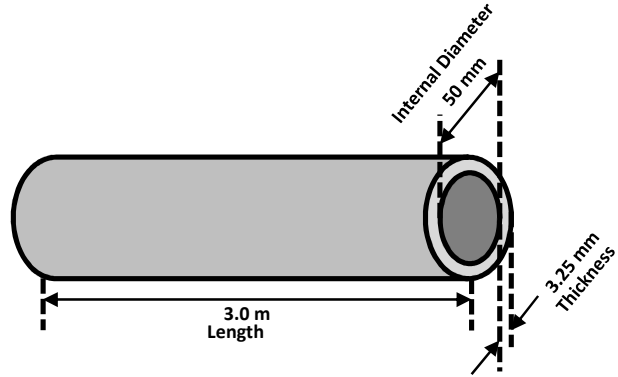


Figure 2 - Duct No. 56D Duct dimensions

Material used in manufacturing Duct no.'s 54D & 56D is Poly Vinyl Chloride (PVC). The Duct no.'s 54D & 56D may be laid as a single or in a multi way formation (duct bank) as follows:

- 1) Up to and including 9 ways in a rectangular formation
- 2) Over 9 ways in rectangular formation with concrete surround (Not applicable for Duct No. 56D).

The multi way formation (Duct bank) configurations are typically dependent upon available space and the adjacent building or manhole entrance, and may have to be altered to avoid conflicts with other utilities.

Each duct length has a tapered socket at one end which will accept the normal barrel of the duct as shown in figure below

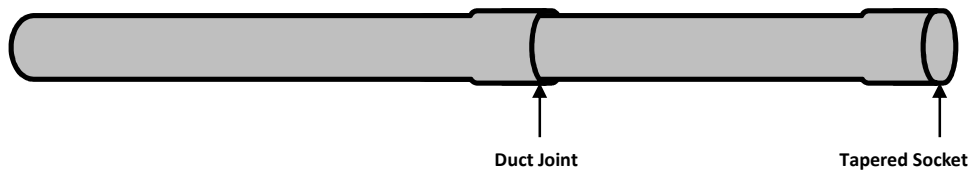


Figure 3 - Duct with tapered socket end

Minimum bending radius of the ducts is:

- 5 meters for duct no. 54D
- 9.5 meters for Duct no. 56D

The standard depth of the Duct network from the ground level to the duct line is 600mm as shown below:

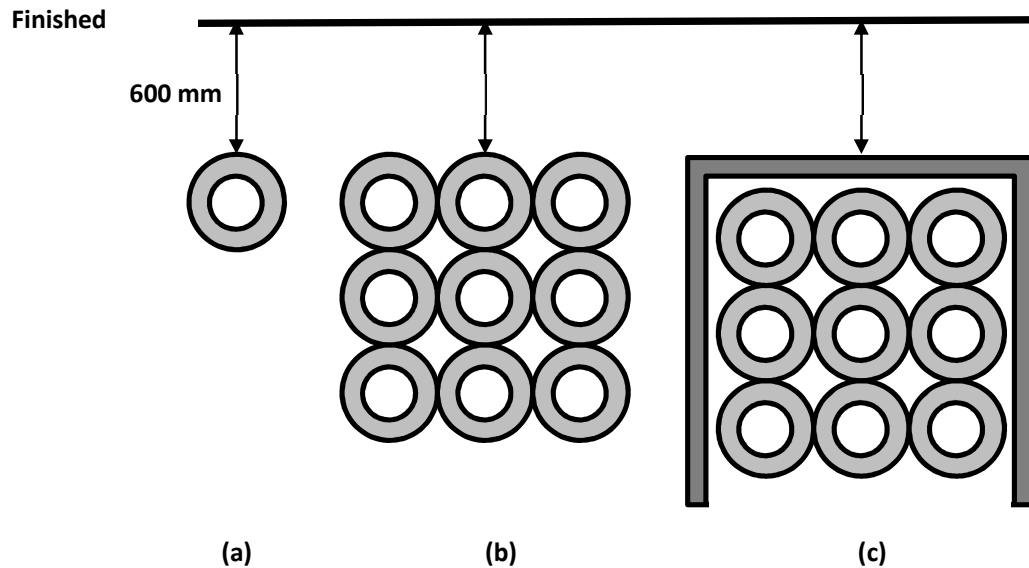


Figure 4 – Lusail Duct Network Depth in the cases of (a) single duct (b) Duct bank (c) Duct bank with Concrete surround

Cable Chambers (such as joint boxes and manholes) are placed at intervals of distances between 250 m and 500 m along a cable duct system for the purpose of pulling in bending and jointing cables.

Cable chambers are constructed using reinforced concrete and are fitted with triangular covers which are capable of withstanding the maximum carriage way loading and are resistant to corrosion.

6 Guidelines for Building Designers

The building structures detailed in this section have been prepared based on the plot development plan within Lusail Smart City and are provided as illustrations and guidance. It is understood that each individual building will have specific floor plans, wall layouts and distinct room locations that will necessitate customised cable pathways and node locations.

6.1. General Conformance for all Building Structures

6.1.1. Containments

6.1.1.1. Specifications

The developer has the choice to use any solution to provide the containment needed for smart service as per his/her needs and applications as detailed in Version 6.0 of “Internal Wiring Guidelines” published on February 28th, 2013 for further details. Below are some of these recommended containments types:

1. PVC or UPVC pipes
2. GI Pipes
3. GI cable trays
4. Micro ducts (for air blown applications)

Developer has the right to use any other material subject to suitability for telecom cable laying.

6.1.1.2. General Requirements

- All containments shall be continuous and without any gaps or disconnects.
- All closed type containments such as pipes and conduits shall not be longer than 30m or contain more than two 90 degree bends between pull boxes and shall have pulling rope inside them to facilitate cable pulling.
- All containments must be compliant with “Internal Cabling Guidelines” version 6.0 published by ICT Qatar on February 28th 2013.

6.1.2. Cables

6.1.2.1. Specifications

The Developer has the choice to use either copper or fibre optic cables to connect the smart services as per his/her needs and applications as detailed in “Internal Wiring Guidelines” v6.0.

- All copper cable elements (twisted copper pairs) must be rated at Category-6 or better.
- All Optical Fibre elements must be Single Mode (SM) and compliant with ITU-T G.657.A2 & “Internal Cabling Guidelines” version 6.0 published by ICT Qatar on February 28th 2013.

6.1.2.2. General Requirements

- For CAT6 copper cable span between Patch Panel and Socket shall not exceed 90m in length. This is to allow for 10m of patching.
- All CAT6 spans must be continuous - middle joints are not allowed.
- All Fibre splices in internal wiring are to be “Fusion Spliced”. Typical splice attenuation shall not exceed 0.05dB
- All elements of internal wiring must be labelled properly to simplify operation and maintenance work. Labels on elements must match the label in the documentation and the labels at each end of single span shall correlate in description and colour. Various methods and strategies of identification can be used including printing on cable jackets along with printed or coloured tags at cable/fibre termination points.
- The minimum bending radius, expressed as a multiple of the overall cable diameter, shall be 20 times the cable outer diameter when under the maximum rated pulling tension for Single Mode fibre cables and 10 times when unloaded.

6.2. Residential Structures

6.2.1. Multi Dwelling Unit Building

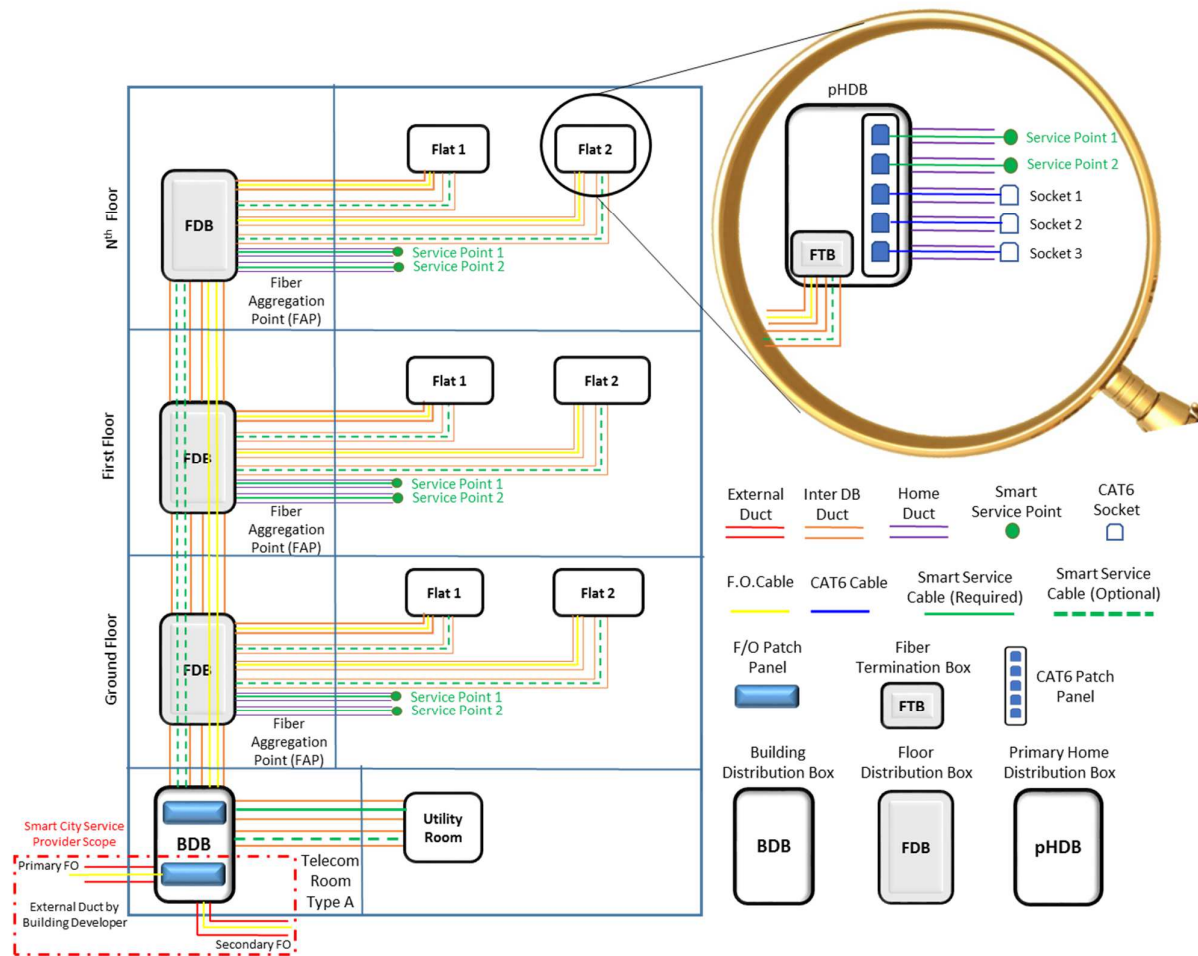


Figure 5 - Multi Dwelling Unit Building

6.2.1.1. Containment Requirements

- Each **Utility Room (UR)** that is part of smart city services shall be connected to telecom room (TR) with 2 (TWO) separate containments, each suitable to carry 1 (ONE) Fibre Optic Cable of 12F and 2 (TWO) CAT6 cables. These containments' length shall not exceed in any case 80m. If the distance between UR and TR is more than 80m, then UR shall be connected to the nearest Floor Aggregation Point (FAP).
- Each **Flat** shall be connected to the nearest FAP with 2 (TWO) containments, each sufficient to carry 1 (ONE) Fibre Optic Cable of 12F and 2 CAT6 cables. These containments' length shall not exceed in any case 80m.
- Each **Service Point within the Building and outside the Flat** shall be connected to the nearest FAP with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.

- Each **Service Point within the Flat** shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.
- Risers shall be designed to have enough capacity to accommodate all the cables (fibre or copper) that are required to travel between distribution boxes. The final riser sizing will depend on the cable deployment option that is adopted by the building designer.

6.2.1.2. Cabling Requirements

- **Utility Room (UR)** shall be connected with either 1 (ONE) 12F fibre optic cable or 2 (TWO) Cat6 cables to the telecom room. Cat6 cables can be deployed provided that the distance from the utility room to the telecom room does not exceed 90m and the bandwidth requirements for the end points are satisfied. For distances above 90m, Fibre optic cable is recommended.
- Each **Flat** shall be connected to the nearest FAP with 1 (ONE) 12F Fibre optic cable to telecom room. The 12F usage are as follows 4F for telecom, 4F for smart services and 4F are reserved for maintenance and future service expansions.
- Each **Service Point within the Building and outside the Flat** shall be connected to the nearest FAP with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Each **Service Point within the Flat** shall be connected to the Primary Home Distribution Box (pHDB) with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Riser cables shall have enough capacity to accommodate the total number of fibres (telecom + smart services) connected to each Floor Aggregation Point (FAP) and spare capacity for each floor.
- The final riser cable sizing will depend on the cable deployment option that is adopted by the building designer. The adopted cable deployment for the building will be compliant with the deployment options addressed in Section 7.2, under Note 1, of the "Internal Cabling Guidelines" version 6.0 published by ICT Qatar on February 28th, 2013.

6.2.1.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the BDB to the PHDB located inside in the Flat, to the service points on each floor and to the Utility rooms (UR). The external duct from Telecom room to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibre from LAN to the building including termination of the fibres on a patch panel in the BDB.

6.2.2. Single Villa with One Floor / Multiple Floors

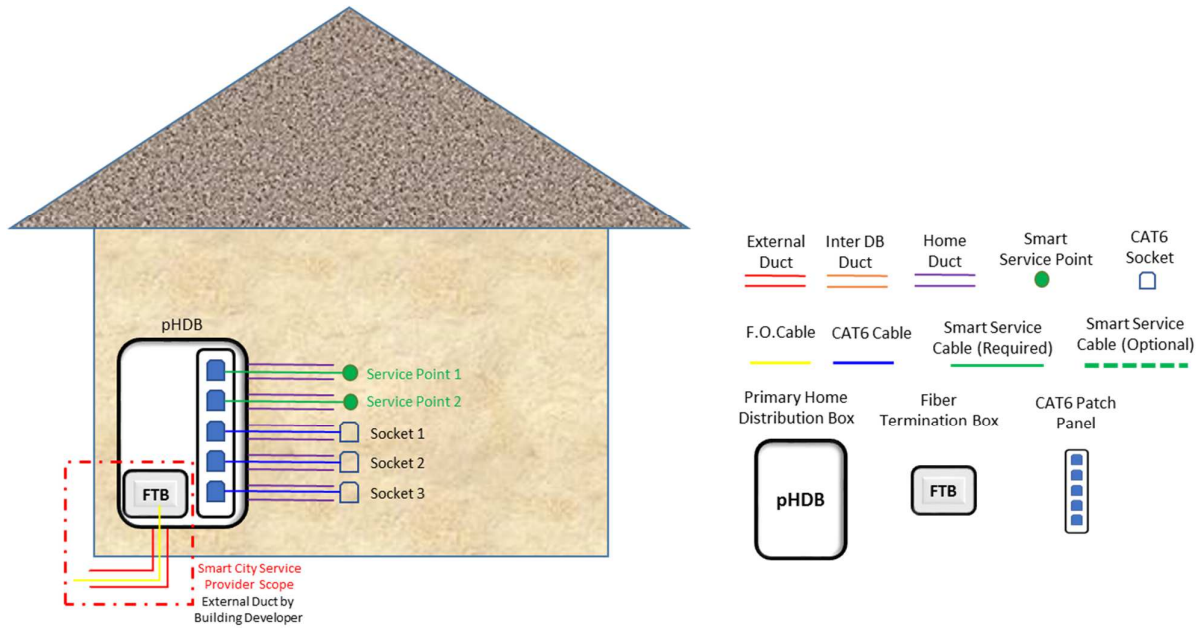


Figure 6 – Single Villa with One Floor

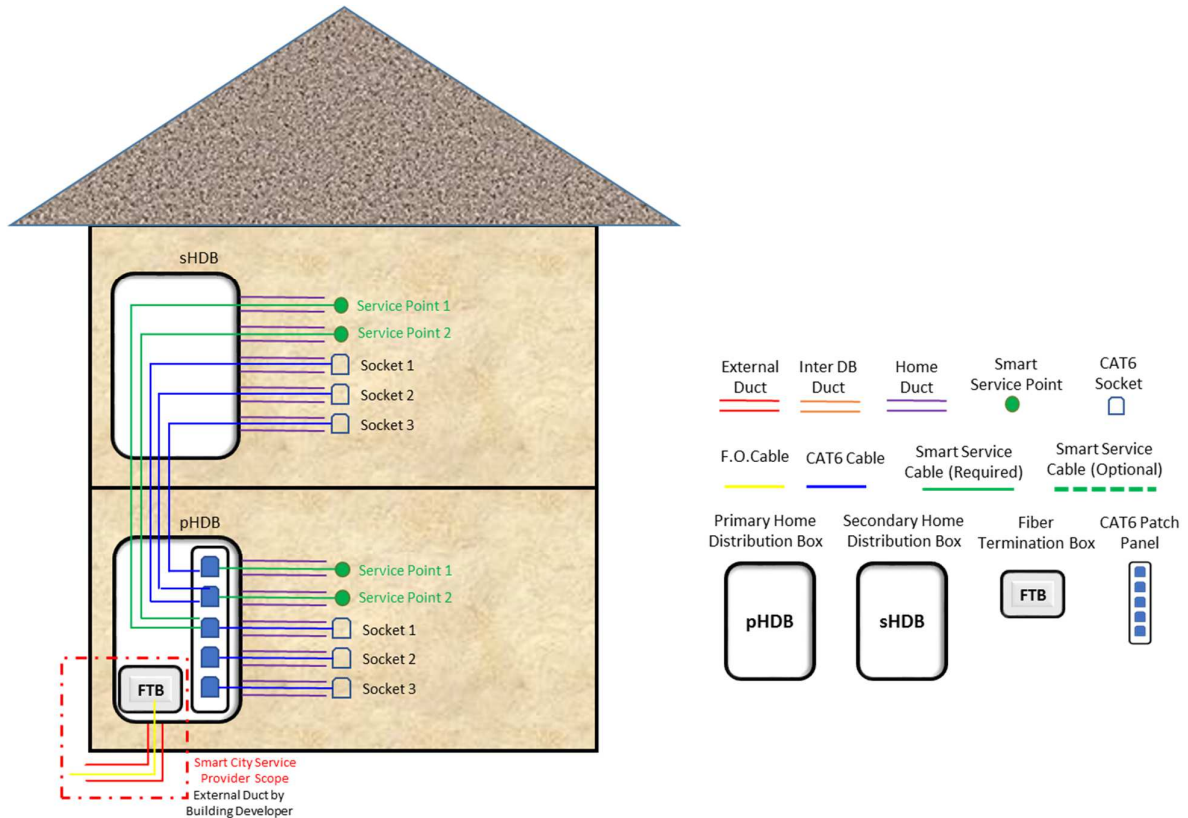


Figure 7 – Single Villa with Multiple Floors

Note 1: If the total number of sockets on floors other than the ground floor is more than 4, the customer has the option to use active equipment (Ethernet switch) in the SHDB to minimize the number of riser cables. The Ethernet switch will not be supplied by SP or ANP.

Note 2: If the Category-6 cable length between sockets and copper patch panel is more than 90m, designer has to use active component (Ethernet switch) in the SHDB.

6.2.2.1. Containment Requirements

Each Service Point shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m. If the distance between Service Point and pHDB is more than 80m, then Service Point shall be connected to the nearest Secondary Home Distribution Box (sHDB).

6.2.2.2. Cabling Requirements

Each Service Point shall be connected to the Primary Home Distribution Box (pHDB) with either fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint. If the distance between Service Point and pHDB is more than 90m, then Service Point shall be connected to the nearest Secondary Home Distribution Box (sHDB).

6.2.2.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the PHDB located inside the villa and to the service points on each floor. The external duct from PHDB to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibres from LAN to the building including termination of the fibres on the FTB.

6.3. Commercial / Retail (Shopping Mall)

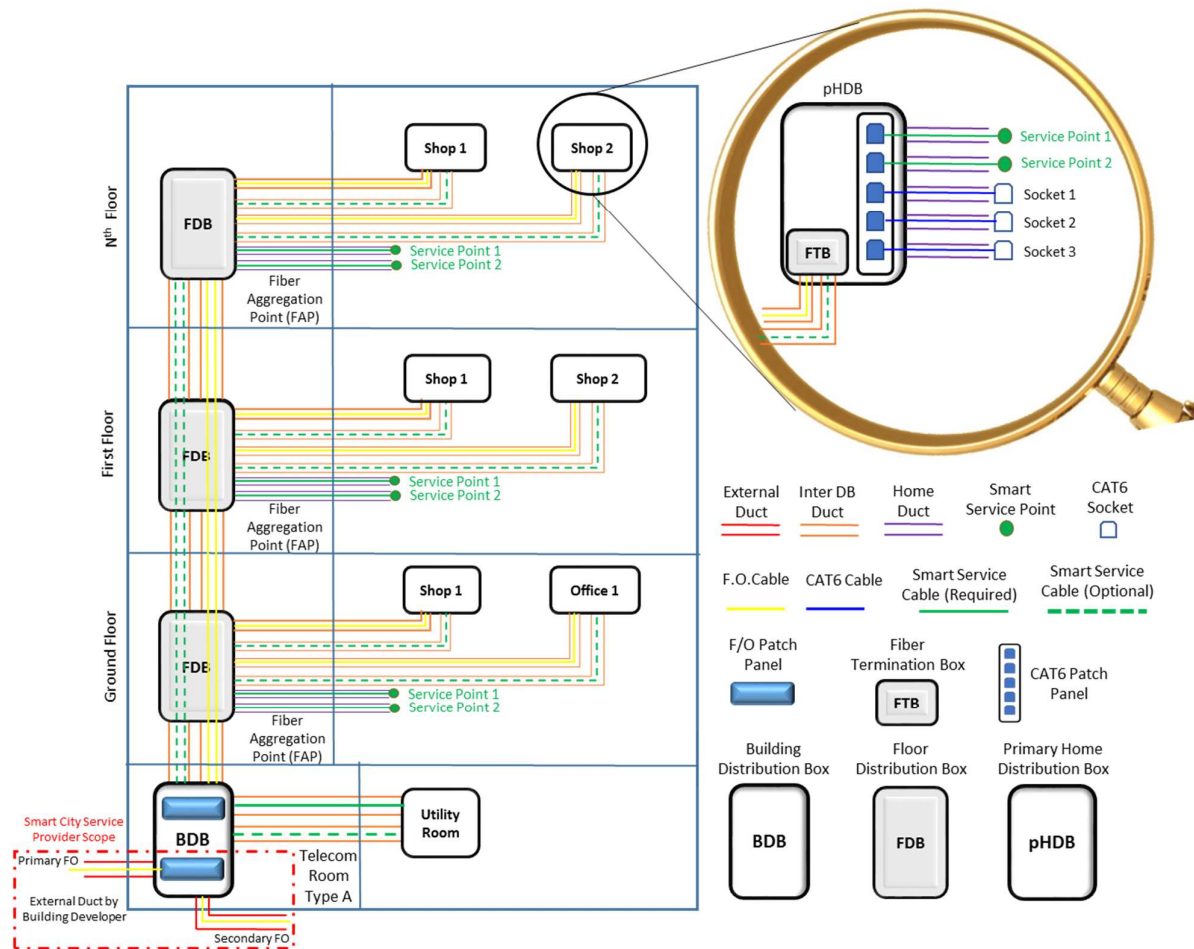


Figure 8 - Commercial / Retail (Shopping Mall)

6.3.1. Containment Requirements

- Each **Utility Room (UR)** that is part of smart city services shall be connected to telecom room (TR) with 2 (TWO) separate containments, each suitable to carry 1 (ONE) Fibre Optic Cable of 12F and 2 (TWO) CAT6 cables. These containments' length shall not exceed in any case 80m. If the distance between UR and TR is more than 80m, then UR shall be connected to the nearest Floor Aggregation Point (FAP).
- Each **Shop/Office** shall be connected to the nearest FAP with 2 (TWO) containments, each sufficient to carry 1 (ONE) Fibre Optic Cable of 12F and 2 CAT6 cables. These containments' length shall not exceed in any case 80m.
- Each **Service Point within the Building and outside the Shop/Office** shall be connected to the nearest FAP with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.
- Each **Service Point within the Shop/Office** shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.

- Risers shall be designed to have enough capacity to accommodate all the cables (Fibre or copper) that are required to travel between distribution boxes. The final riser sizing will depend on the cable deployment option that is adopted by the building designer.

6.3.2. Cabling Requirements

- **Utility Room (UR)** shall be connected with either 1 (ONE) 12F Fibre optic cable or 2 (TWO) Cat6 cables to the telecom room. Cat6 cables can be deployed provided that the distance from the utility room to the telecom room does not exceed 90m and the bandwidth requirements for the end points are satisfied. For distances above 90m, Fibre optic cable is recommended.
- Each **Shop/Office** shall be connected to the nearest FAP with 1 (ONE) 12F Fibre optic cable to telecom room. The 12F usage are as follows 4F for telecom, 4F for smart services and 4F are reserved for maintenance and future service expansions.
- Each **Service Point within the Building and outside the Shop/Office** shall be connected to the nearest FAP with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Each **Service Point within the Shop/office** shall be connected to the Primary Home Distribution Box (pHDB) with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Riser cables shall have enough capacity to accommodate the total number of fibres (telecom + smart services) connected to each Floor Aggregation Point (FAP) and spare capacity for each floor.
- The final riser cable sizing will depend on the cable deployment option that is adopted by the building designer. The adopted cable deployment for the building will be compliant with the deployment options addressed in Section 7.2, under Note 1, of the “Internal Cabling Guidelines” version 6.0 published by ICT Qatar on February 28th, 2013.

6.3.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the BDB to the PHDB located inside the Shop/Office, to the service points on each floor and to the Utility rooms (UR). The external duct from Telecom room to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibre from LAN to the building including termination of the fibres on a patch panel in the BDB.

6.4. Mixed Use (Residential & Commercial) Building

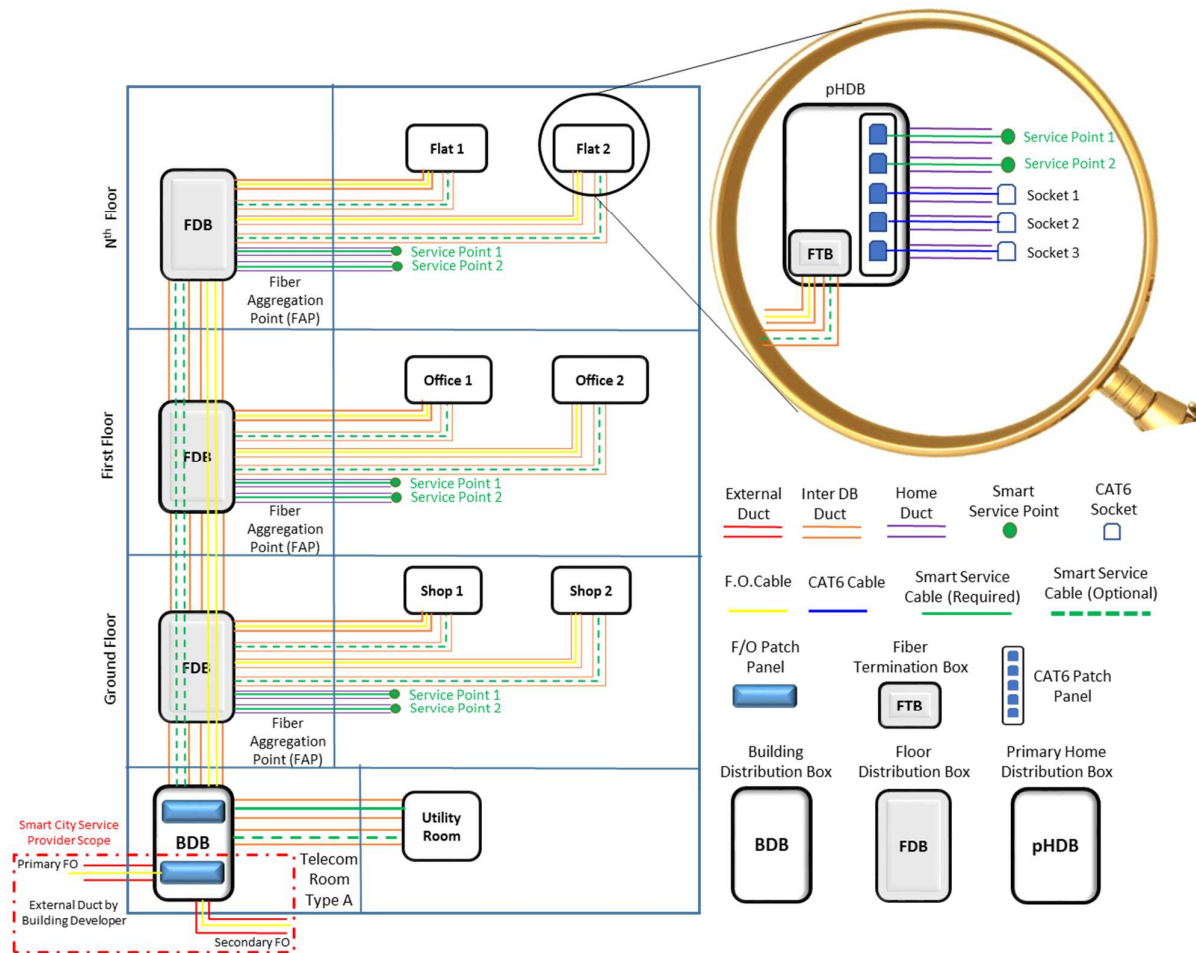


Figure 9 - Mixed Use (Residential & Commercial) Building

6.4.1. Containment Requirements

- Each **Utility Room (UR)** that is part of smart city services shall be connected to telecom room (TR) with 2 (TWO) separate containments, each suitable to carry 1 (ONE) Fibre Optic Cable of 12F and 2 (TWO) CAT6 cables. These containments' length shall not exceed in any case 80m. If the distance between UR and TR is more than 80m, then UR shall be connected to the nearest Floor Aggregation Point (FAP).
- Each **Shop/Office/Flat** shall be connected to the nearest FAP with 2 (TWO) containments, each sufficient to carry 1 (ONE) Fibre Optic Cable of 12F and 2 CAT6 cables. These containments' length shall not exceed in any case 80m.
- Each **Service Point within the Building and outside the Shop/Office/Flat** shall be connected to the nearest FAP with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.
- Each **Service Point within the Shop/Office/Flat** shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.

- Risers shall be designed to have enough capacity to accommodate all the cables (Fibre or copper) that are required to travel between distribution boxes. The final riser sizing will depend on the cable deployment option that is adopted by the building designer.

6.4.2. Cabling Requirements

- **Utility Room (UR)** shall be connected with either 1 (ONE) 12F Fibre optic cable or 2 (TWO) Cat6 cables to the telecom room. Cat6 cables can be deployed provided that the distance from the utility room to the telecom room does not exceed 90m and the bandwidth requirements for the end points are satisfied. For distances above 90m, Fibre optic cable is recommended.
- Each **Shop/Office/Flat** shall be connected to the nearest FAP with 1 (ONE) 12F Fibre optic cable to telecom room. The 12F usage are as follows 4F for telecom, 4F for smart services and 4F are reserved for maintenance and future service expansions.
- Each **Service Point within the Building and outside the Shop/Office/Flat** and outside the apartment shall be connected to the nearest FAP with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Each **Service Point within the Shop/Office/Flat** shall be connected to the Primary Home Distribution Box (pHDB) with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Riser cables shall have enough capacity to accommodate the total number of fibres (telecom + smart services) connected to each Floor Aggregation Point (FAP) and spare capacity for each floor.
- The final riser cable sizing will depend on the cable deployment option that is adopted by the building designer. The adopted cable deployment for the building will be compliant with the deployment options addressed in Section 7.2, under Note 1, of the “Internal Cabling Guidelines” version 6.0 published by ICT Qatar on February 28th, 2013.

6.4.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the BDB to the PHDB located inside the Shop/Office/Flat, to the service points on each floor and to the Utility rooms (UR). The external duct from Telecom room to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibre from LAN to the building including termination of the fibres on a patch panel in the BDB.

6.5. Hotels

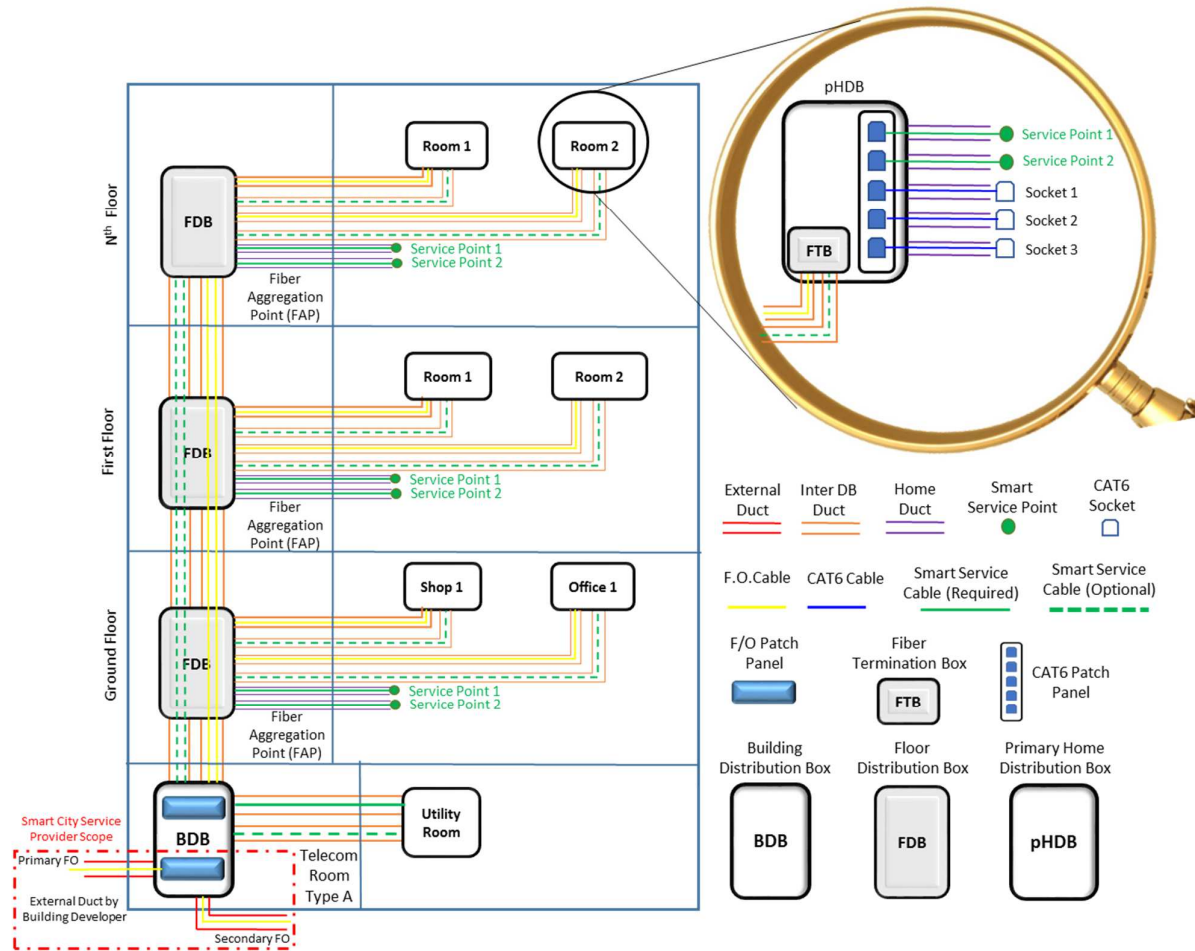


Figure 10 – Hotels

6.5.1. Containment Requirements

- Each **Utility Room (UR)** that is part of smart city services shall be connected to telecom room (TR) with 2 (TWO) separate containments, each suitable to carry 1 (ONE) Fibre Optic Cable of 12F and 2 (TWO) CAT6 cables. These containments' length shall not exceed in any case 80m. If the distance between UR and TR is more than 80m, then UR shall be connected to the nearest Floor Aggregation Point (FAP).
- Each **Shop/Office/Room** shall be connected to the nearest FAP with 2 (TWO) containments, each sufficient to carry 1 (ONE) Fibre Optic Cable of 12F and 2 CAT6 cables. These containments' length shall not exceed in any case 80m.
- Each **Service Point within the Building and outside the Shop/Office/Room** shall be connected to the nearest FAP with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.
- Each **Service Point within the Shop/Office/Room** shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.

- Risers shall be designed to have enough capacity to accommodate all the cables (Fibre or copper) that are required to travel between distribution boxes. The final riser sizing will depend on the cable deployment option that is adopted by the building designer.

6.5.2. Cabling Requirements

- **Utility Room (UR)** shall be connected with either 1 (ONE) 12F Fibre optic cable or 2 (TWO) Cat6 cables to the telecom room. Cat6 cables can be deployed provided that the distance from the utility room to the telecom room does not exceed 90m and the bandwidth requirements for the end points are satisfied. For distances above 90m, Fibre optic cable is recommended.
- Each **Shop/Office/Room** shall be connected to the nearest FAP with 1 (ONE) 12F Fibre optic cable to telecom room. The 12F usage are as follows 4F for telecom, 4F for smart services and 4F are reserved for maintenance and future service expansions.
- Each **Service Point within the Building and outside the Shop/Office/Room** shall be connected to the nearest FAP with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Each **Service Point within the Shop/Office/Room** shall be connected to the Primary Home Distribution Box (pHDB) with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Riser cables shall have enough capacity to accommodate the total number of fibres (telecom + smart services) connected to each Floor Aggregation Point (FAP) and spare capacity for each floor.
- The final riser cable sizing will depend on the cable deployment option that is adopted by the building designer. The adopted cable deployment for the building will be compliant with the deployment options addressed in Section 7.2, under Note 1, of the “Internal Cabling Guidelines” version 6.0 published by ICT Qatar on February 28th, 2013.

6.5.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the BDB to the PHDB located inside the Shop/Office/Room, to the service points on each floor and to the Utility rooms (UR). The external duct from Telecom room to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibre from LAN to the building including termination of the fibres on a patch panel in the BDB.

6.6. Hospital / Medical Centre

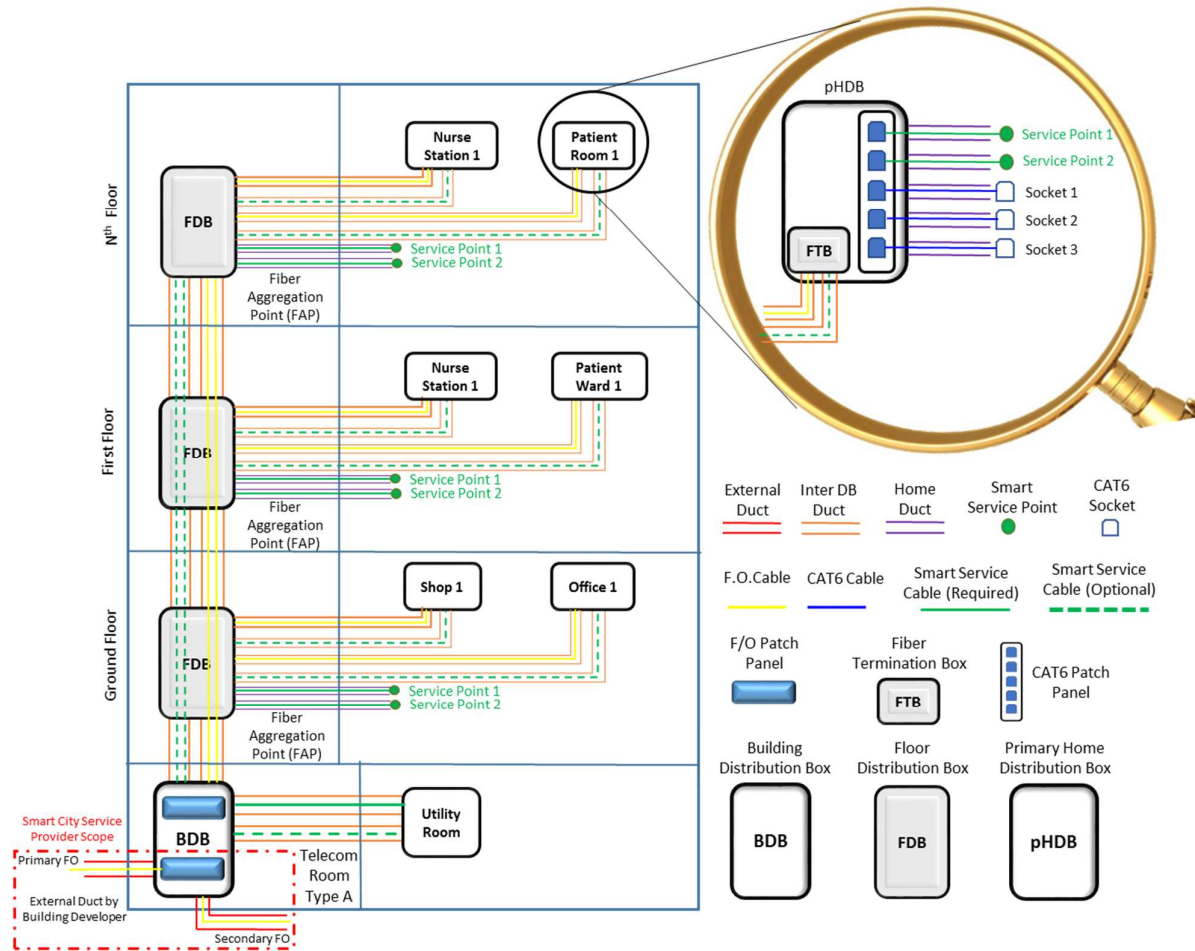


Figure 11 - Hospital / Medical Centre

6.6.1. Containment Requirements

- Each **Utility Room (UR)** that is part of smart city services shall be connected to telecom room (TR) with 2 (TWO) separate containments, each suitable to carry 1 (ONE) Fibre Optic Cable of 12F and 2 (TWO) CAT6 cables. These containments' length shall not exceed in any case 80m. If the distance between UR and TR is more than 80m, then UR shall be connected to the nearest Floor Aggregation Point (FAP).
- Each **Shop/Office/Nurse Station/Patient Ward/Patient Room** shall be connected to the nearest FAP with 2 (TWO) containments, each sufficient to carry 1 (ONE) Fibre Optic Cable of 12F and 2 CAT6 cables. These containments' length shall not exceed in any case 80m.
- Each **Service Point within the Building and outside the Shop/Office/Nurse Station/Patient Ward/Patient Room** shall be connected to the nearest FAP with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.
- Each **Service Point within the Shop/Office/Nurse Station/Patient Ward/Patient Room** shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry

1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.

- Risers shall be designed to have enough capacity to accommodate all the cables (Fibre or copper) that are required to travel between distribution boxes. The final riser sizing will depend on the cable deployment option that is adopted by the building designer.

6.6.2. Cabling Requirements

- **Utility Room (UR)** shall be connected with either 1 (ONE) 12F Fibre optic cable or 2 (TWO) Cat6 cables to the telecom room. Cat6 cables can be deployed provided that the distance from the utility room to the telecom room does not exceed 90m and the bandwidth requirements for the end points are satisfied. For distances above 90m, fibre optic cable is recommended.
- Each **Shop/Office/Nurse Station/Patient Ward/Patient Room** shall be connected to the nearest FAP with 1 (ONE) 12F Fibre optic cable to telecom room. The 12F usage are as follows 4F for telecom, 4F for smart services and 4F are reserved for maintenance and future service expansions.
- Each **Service Point within the Building and outside the Shop/Office/Nurse Station/Patient Ward/Patient Room** shall be connected to the nearest FAP with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Each **Service Point within the Shop/Office/Nurse Station/Patient Ward/Patient Room** shall be connected to the Primary Home Distribution Box (pHDB) with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Riser cables shall have enough capacity to accommodate the total number of fibres (telecom + smart services) connected to each Floor Aggregation Point (FAP) and spare capacity for each floor.
- The final riser cable sizing will depend on the cable deployment option that is adopted by the building designer. The adopted cable deployment for the building will be compliant with the deployment options addressed in Section 7.2, under Note 1, of the "Internal Cabling Guidelines" version 6.0 published by ICT Qatar on February 28th, 2013.

6.6.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the BDB to the PHDB located inside the Shop/Office/Nurse Station/Patient Ward/Patient Room, to the service points on each floor and to the Utility rooms (UR). The external duct from Telecom room to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibre from LAN to the building including termination of the fibres on a patch panel in the BDB.

6.7. Office Building

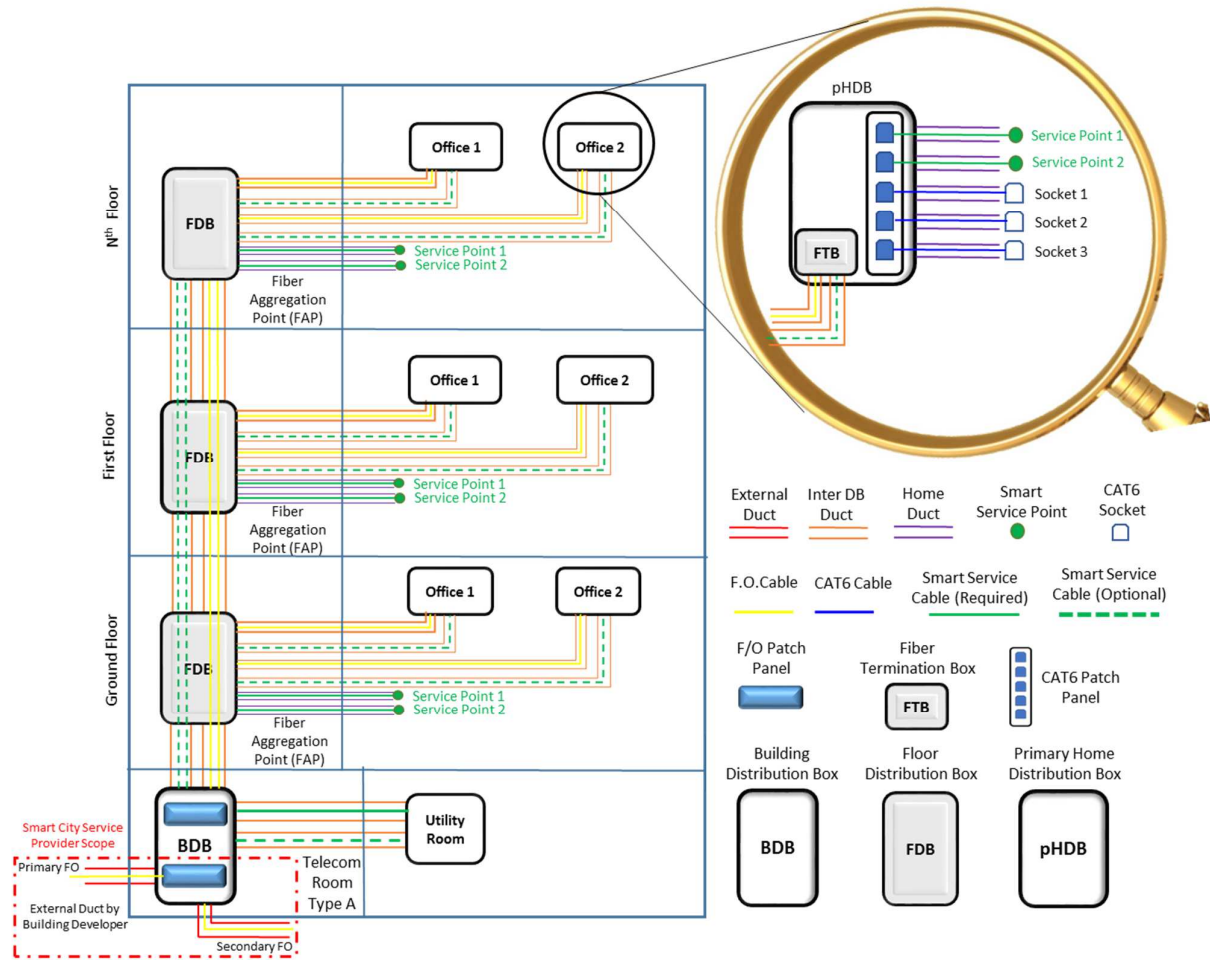


Figure 12 - Office Building

6.7.1. Containment Requirements

- Each **Utility Room (UR)** that is part of smart city services shall be connected to telecom room (TR) with 2 (TWO) separate containments, each suitable to carry 1 (ONE) Fibre Optic Cable of 12F and 2 (TWO) CAT6 cables. These containments' length shall not exceed in any case 80m. If the distance between UR and TR is more than 80m, then UR shall be connected to the nearest Floor Aggregation Point (FAP).
- Each **Office** shall be connected to the nearest FAP with 2 (TWO) containments, each sufficient to carry 1 (ONE) Fibre Optic Cable of 12F and 2 CAT6 cables. These containments' length shall not exceed in any case 80m.
- Each **Service Point within the Building and outside the Office** shall be connected to the nearest FAP with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.
- Each **Service Point within Office** shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.

- Risers shall be designed to have enough capacity to accommodate all the cables (Fibre or copper) that are required to travel between distribution boxes. The final riser sizing will depend on the cable deployment option that is adopted by the building designer.

6.7.2. Cabling Requirements

- **Utility Room (UR)** shall be connected with either 1 (ONE) 12F Fibre optic cable or 2 (TWO) Cat6 cables to the telecom room. Cat6 cables can be deployed provided that the distance from the utility room to the telecom room does not exceed 90m and the bandwidth requirements for the end points are satisfied. For distances above 90m, Fibre optic cable is recommended.
- Each **Office** shall be connected to the nearest FAP with 1 (ONE) 12F Fibre optic cable to telecom room. The 12F usage are as follows 4F for telecom, 4F for smart services and 4F are reserved for maintenance and future service expansions.
- Each **Service Point within the Building and outside the office** shall be connected to the nearest FAP with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Each **Service Point within the Office** shall be connected to the Primary Home Distribution Box (pHDB) with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Riser cables shall have enough capacity to accommodate the total number of fibres (telecom + smart services) connected to each Floor Aggregation Point (FAP) and spare capacity for each floor.
- The final riser cable sizing will depend on the cable deployment option that is adopted by the building designer. The adopted cable deployment for the building will be compliant with the deployment options addressed in Section 7.2, under Note 1, of the “Internal Cabling Guidelines” version 6.0 published by ICT Qatar on February 28th, 2013.

6.7.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the BDB to the PHDB located inside the Office, to the service points on each floor and to the Utility rooms (UR). The external duct from Telecom room to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibre from LAN to the building including termination of the fibres on a patch panel in the BDB.

6.8. Institutional / Schools

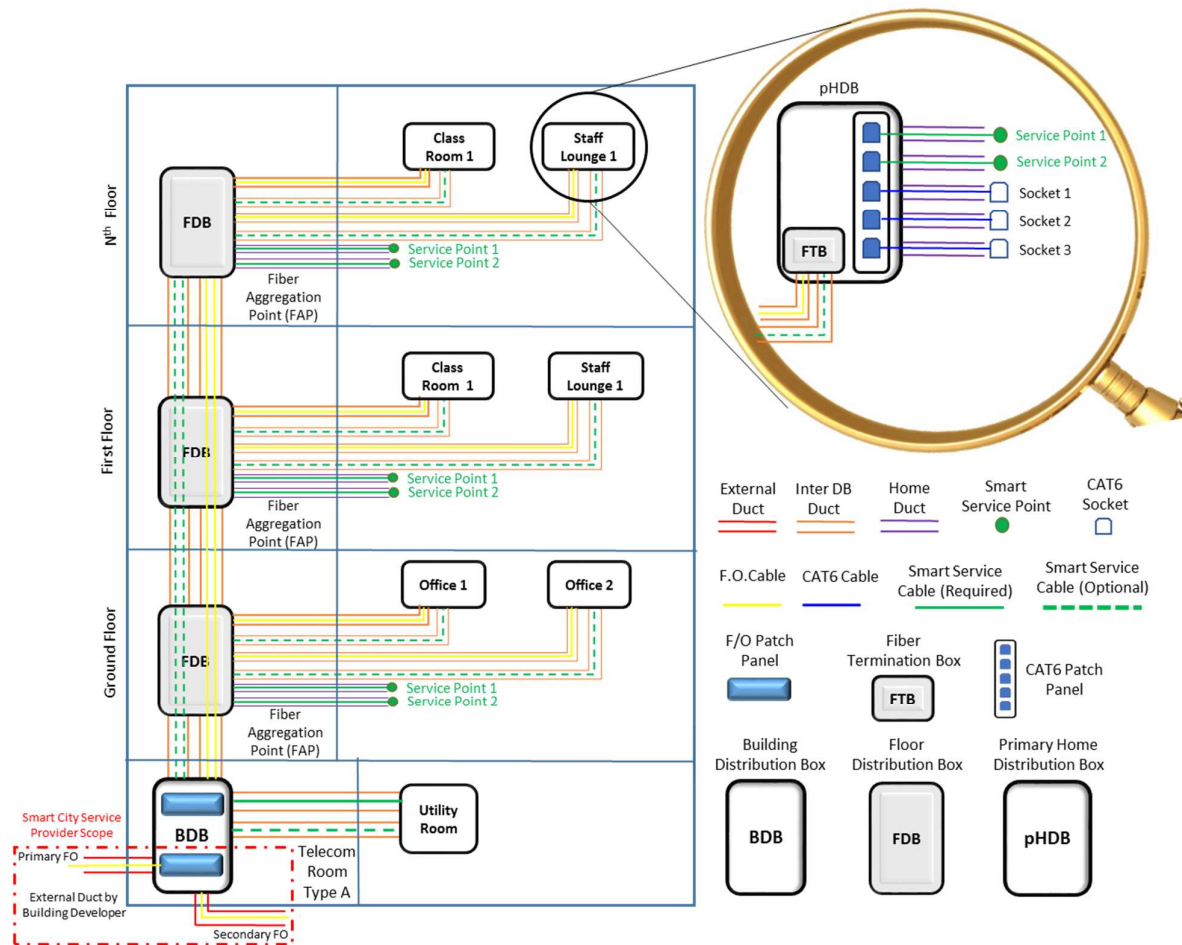


Figure 13 - Institutional / Schools

6.8.1. Containment Requirements

- Each **Utility Room (UR)** that is part of smart city services shall be connected to telecom room (TR) with 2 (TWO) separate containments, each suitable to carry 1 (ONE) Fibre Optic Cable of 12F and 2 (TWO) CAT6 cables. These containments' length shall not exceed in any case 80m. If the distance between UR and TR is more than 80m, then UR shall be connected to the nearest Floor Aggregation Point (FAP).
- Each **Office/Class Room/Staff Lounge** shall be connected to the nearest FAP with 2 (TWO) containments, each sufficient to carry 1 (ONE) Fibre Optic Cable of 12F and 2 CAT6 cables. These containments' length shall not exceed in any case 80m.
- Each **Service Point within the Building and outside the Office/Class Room/Staff Lounge** shall be connected to the nearest FAP with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.
- Each **Service Point within the Office/Class Room/Staff Lounge** shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.

- Risers shall be designed to have enough capacity to accommodate all the cables (Fibre or copper) that are required to travel between distribution boxes. The final riser sizing will depend on the cable deployment option that is adopted by the building designer.

6.8.2. Cabling Requirements

- **Utility Room (UR)** shall be connected with either 1 (ONE) 12F Fibre optic cable or 2 (TWO) Cat6 cables to the telecom room. Cat6 cables can be deployed provided that the distance from the utility room to the telecom room does not exceed 90m and the bandwidth requirements for the end points are satisfied. For distances above 90m, Fibre optic cable is recommended.
- Each **Office/Class Room/Staff Lounge** shall be connected to the nearest FAP with 1 (ONE) 12F Fibre optic cable to telecom room. The 12F usage are as follows 4F for telecom, 4F for smart services and 4F are reserved for maintenance and future service expansions.
- Each **Service Point within the Building and outside the Office/Class Room/Staff** shall be connected to the nearest FAP with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Each **Service Point within the Office/Class Room/Staff Lounge** shall be connected to the Primary Home Distribution Box (pHDB) with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Riser cables shall have enough capacity to accommodate the total number of fibres (telecom + smart services) connected to each Floor Aggregation Point (FAP) and spare capacity for each floor.
- The final riser cable sizing will depend on the cable deployment option that is adopted by the building designer. The adopted cable deployment for the building will be compliant with the deployment options addressed in Section 7.2, under Note 1, of the “Internal Cabling Guidelines” version 6.0 published by ICT Qatar on February 28th, 2013.

6.8.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the BDB to the PHDB located inside the Office/Class Room/Staff Lounge, to the service points on each floor and to the Utility rooms (UR). The external duct from Telecom room to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibre from LAN to the building including termination of the fibres on a patch panel in the BDB.

6.9. Exhibition Centres / Convention Centres / Multipurpose Halls

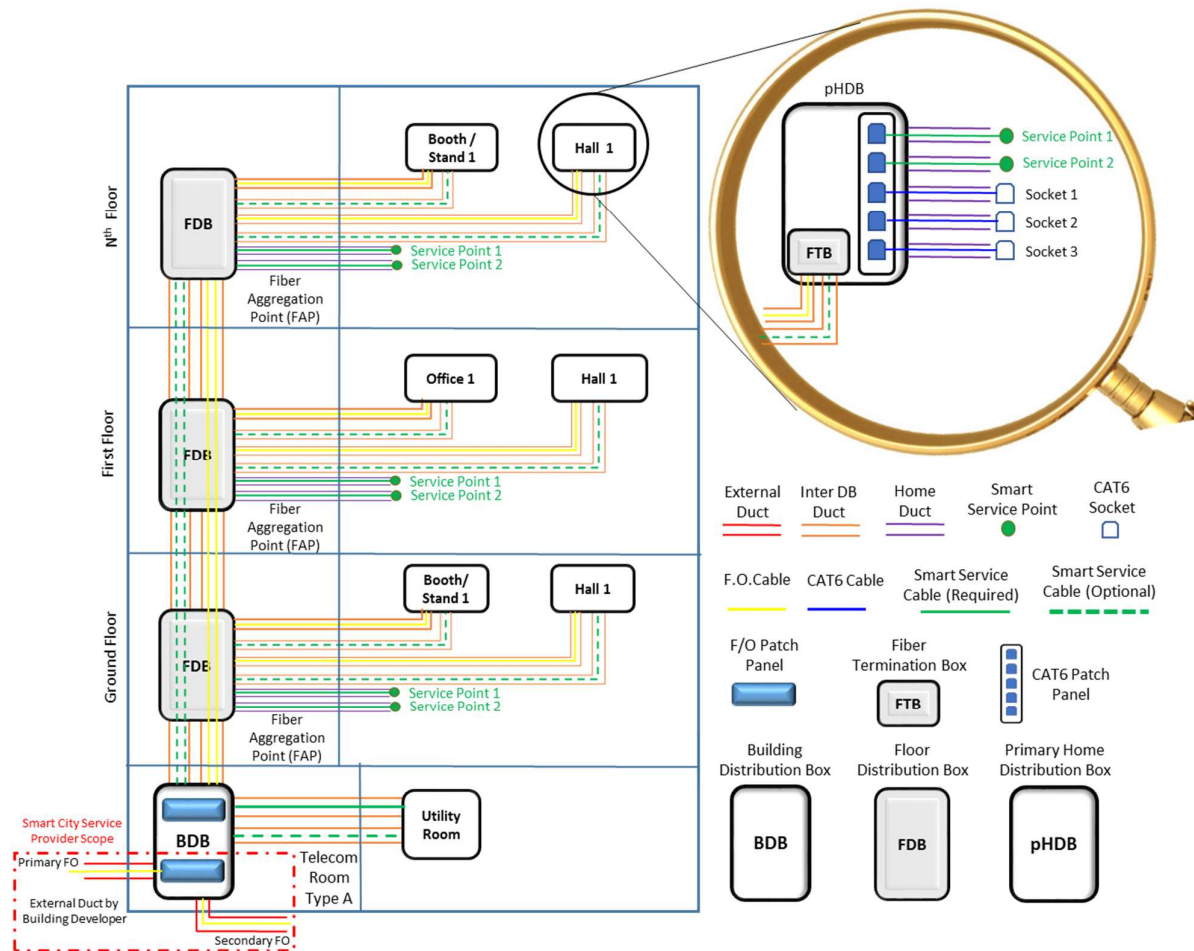


Figure 14 - Exhibition Centres / Convention Centres / Multipurpose Halls

6.9.1. Containment Requirements

- Each **Utility Room (UR)** that is part of smart city services shall be connected to telecom room (TR) with 2 (TWO) separate containments, each suitable to carry 1 (ONE) Fibre Optic Cable of 12F and 2 (TWO) CAT6 cables. These containments' length shall not exceed in any case 80m. If the distance between UR and TR is more than 80m, then UR shall be connected to the nearest Floor Aggregation Point (FAP).
- Each **Booth/Stand/Hall/Office** shall be connected to the nearest FAP with 2 (TWO) containments, each sufficient to carry 1 (ONE) Fibre Optic Cable of 12F and 2 CAT6 cables. These containments' length shall not exceed in any case 80m.
- Each **Service Point within the Building and outside the Booth/Stand/Hall/Office** shall be connected to the nearest FAP with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.
- Each **Service Point within the Booth/Stand/Hall/Office** shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.

- Risers shall be designed to have enough capacity to accommodate all the cables (Fibre or copper) that are required to travel between distribution boxes. The final riser sizing will depend on the cable deployment option that is adopted by the building designer.

6.9.2. Cabling Requirements

- **Utility Room (UR)** shall be connected with either 1 (ONE) 12F Fibre optic cable or 2 (TWO) Cat6 cables to the telecom room. Cat6 cables can be deployed provided that the distance from the utility room to the telecom room does not exceed 90m and the bandwidth requirements for the end points are satisfied. For distances above 90m, Fibre optic cable is recommended.
- Each **Booth/Stand/Hall/Office** shall be connected to the nearest FAP with 1 (ONE) 12F Fibre optic cable to telecom room. The 12F usage are as follows 4F for telecom, 4F for smart services and 4F are reserved for maintenance and future service expansions.
- Each **Service Point within the Building and outside the Booth/Stand/Hall/Office** shall be connected to the nearest FAP with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Each **Service Point within the Booth/Stand/Hall/Office** shall be connected to the Primary Home Distribution Box (pHDB) with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Riser cables shall have enough capacity to accommodate the total number of fibres (telecom + smart services) connected to each Floor Aggregation Point (FAP) and spare capacity for each floor.
- The final riser cable sizing will depend on the cable deployment option that is adopted by the building designer. The adopted cable deployment for the building will be compliant with the deployment options addressed in Section 7.2, under Note 1, of the “Internal Cabling Guidelines” version 6.0 published by ICT Qatar on February 28th, 2013.

6.9.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the BDB to the PHDB located inside the Booth/Stand/Hall/Office, to the service points on each floor and to the Utility rooms (UR). The external duct from Telecom room to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibre from LAN to the building including termination of the fibres on a patch panel in the BDB.

6.10. Utility Buildings (Substations/District Cooling Plants/Pump Station)

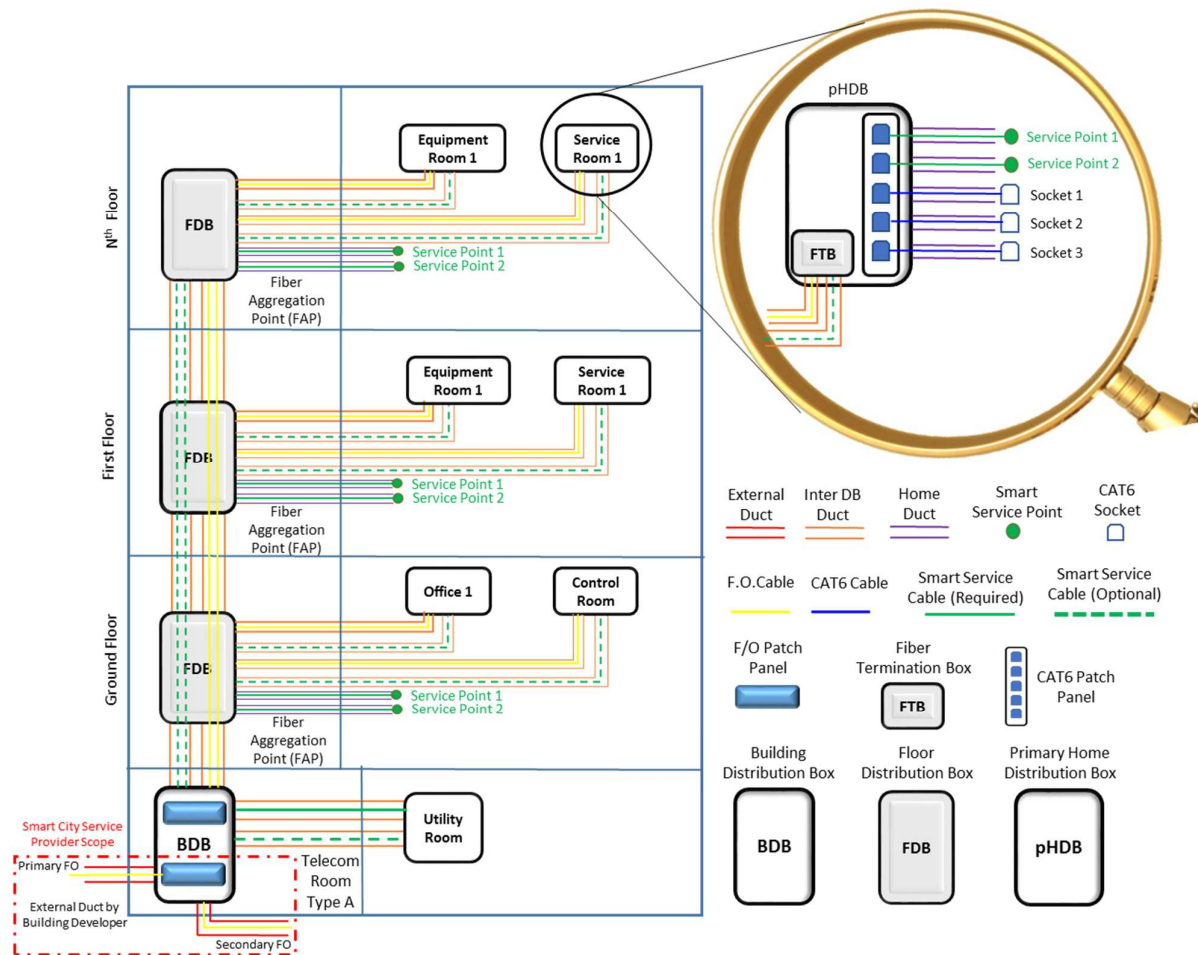


Figure 15 - Utility Buildings (Substations/District Cooling Plants / Pump Station)

6.10.1. Containment Requirements

- Each **Utility Room (UR)** that is part of smart city services shall be connected to telecom room (TR) with 2 (TWO) separate containments, each suitable to carry 1 (ONE) Fibre Optic Cable of 12F and 2 (TWO) CAT6 cables. These containments' length shall not exceed in any case 80m. If the distance between UR and TR is more than 80m, then UR shall be connected to the nearest Floor Aggregation Point (FAP).
- Each **Office/Control Room/Equipment Room/Service Room** shall be connected to the nearest FAP with 2 (TWO) containments, each sufficient to carry 1 (ONE) Fibre Optic Cable of 12F and 2 CAT6 cables. These containments' length shall not exceed in any case 80m.
- Each **Service Point within the Building and outside the Office/Control Room/Equipment Room/Service Room** shall be connected to the nearest FAP with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.
- Each **Service Point within the Office/Control Room/Equipment Room/Service Room** shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry

1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.

- Risers shall be designed to have enough capacity to accommodate all the cables (Fibre or copper) that are required to travel between distribution boxes. The final riser sizing will depend on the cable deployment option that is adopted by the building designer.

6.10.2. Cabling Requirements

- **Utility Room (UR)** shall be connected with either 1 (ONE) 12F fiber optic cable or 2 (TWO) Cat6 cables to the telecom room. Cat6 cables can be deployed provided that the distance from the utility room to the telecom room does not exceed 90m and the bandwidth requirements for the end points are satisfied. For distances above 90m, Fibre optic cable is recommended.
- Each **Office/Control Room/Equipment Room/Service Room** shall be connected to the nearest FAP with 1 (ONE) 12F Fibre optic cable to telecom room. The 12F usage are as follows 4F for telecom, 4F for smart services and 4F are reserved for maintenance and future service expansions.
- Each **Service Point within the Building and outside the Office/Control Room/Equipment Room/Service Room** shall be connected to the nearest FAP with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Each **Service Point within the Office/Control Room/Equipment Room/Service Room** shall be connected to the Primary Home Distribution Box (pHDB) with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Riser cables shall have enough capacity to accommodate the total number of fibres (telecom + smart services) connected to each Floor Aggregation Point (FAP) and spare capacity for each floor.
- The final riser cable sizing will depend on the cable deployment option that is adopted by the building designer. The adopted cable deployment for the building will be compliant with the deployment options addressed in Section 7.2, under Note 1, of the "Internal Cabling Guidelines" version 6.0 published by ICT Qatar on February 28th, 2013.

6.10.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the BDB to the PHDB located inside the Office/Control Room/Equipment Room/Service, to the service points on each floor and to the Utility rooms (UR). The external duct from Telecom room to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibre from LAN to the building including termination of the Fibre on a patch panel in the BDB.

6.11. Car Parks

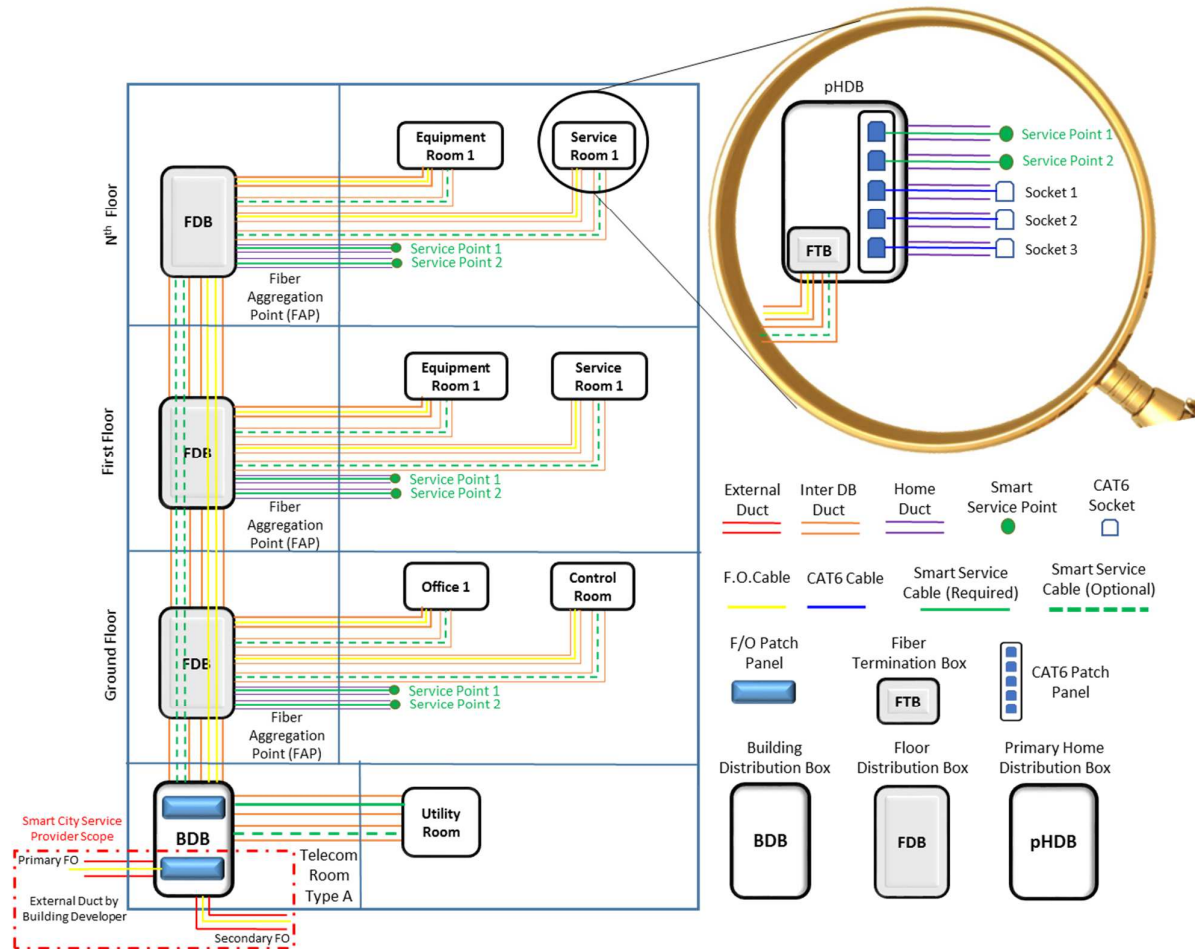


Figure 16 - Car parks

6.11.1. Containment Requirements

- Each **Utility Room (UR)** that is part of smart city services shall be connected to telecom room (TR) with 2 (TWO) separate containments, each suitable to carry 1 (ONE) Fibre Optic Cable of 12F and 2 (TWO) CAT6 cables. These containments' length shall not exceed in any case 80m. If the distance between UR and TR is more than 80m, then UR shall be connected to the nearest Floor Aggregation Point (FAP).
- Each **Office/Control Room/Equipment Room/Service Room** shall be connected to the nearest FAP with 2 (TWO) containments, each sufficient to carry 1 (ONE) Fibre Optic Cable of 12F and 2 CAT6 cables. These containments' length shall not exceed in any case 80m.
- Each **Service Point within the Building and outside the Office/Control Room/Equipment Room/Service Room** shall be connected to the nearest FAP with 1 (ONE) containment sufficient to carry 1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.
- Each **Service Point within the Office/Control Room/Equipment Room/Service Room** shall be connected to the Primary Home Distribution Box (pHDB) with 1 (ONE) containment sufficient to carry

1 (ONE) Fibre Optic Cable of 4F and 2 CAT6 cables. This containment's length shall not exceed in any case 80m.

- Risers shall be designed to have enough capacity to accommodate all the cables (Fibre or copper) that are required to travel between distribution boxes. The final riser sizing will depend on the cable deployment option that is adopted by the building designer.

6.11.2. Cabling Requirements

- **Utility Room (UR)** shall be connected with either 1 (ONE) 12F Fibre optic cable or 2 (TWO) Cat6 cables to the telecom room. Cat6 cables can be deployed provided that the distance from the utility room to the telecom room does not exceed 90m and the bandwidth requirements for the end points are satisfied. For distances above 90m, Fibre optic cable is recommended.
- Each **Office/Control Room/Equipment Room/Service Room** shall be connected to the nearest FAP with 1 (ONE) 12F Fibre optic cable to telecom room. The 12F usage are as follows 4F for telecom, 4F for smart services and 4F are reserved for maintenance and future service expansions.
- Each **Service Point within the Building and outside the Office/Control Room/Equipment Room/Service Room** shall be connected to the nearest FAP with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Each **Service Point within the Office/Control Room/Equipment Room/Service Room** shall be connected to the Primary Home Distribution Box (pHDB) with either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint.
- Riser cables shall have enough capacity to accommodate the total number of Fibres (telecom + smart services) connected to each Floor Aggregation Point (FAP) and spare capacity for each floor.
- The final riser cable sizing will depend on the cable deployment option that is adopted by the building designer. The adopted cable deployment for the building will be compliant with the deployment options addressed in Section 7.2, under Note 1, of the "Internal Cabling Guidelines" version 6.0 published by ICT Qatar on February 28th, 2013.

6.11.3. Scope of Responsibility

Building Developer – Owns, manages and is responsible for the internal wiring from the building side of the BDB to the PHDB located inside the Office/Control Room/Equipment Room/Service Room, to the service points on each floor and to the Utility rooms (UR). The external duct from Telecom room to the property line in order to connect to the LAN.

Smart City Partner – Provision of Fibre from LAN to the building including termination of the fibres on a patch panel in the BDB.

7 Interfacing Requirements

Lusail Smart City is defined by the complex web of integration between systems and services being hosted in LCCC in order to provide Smart services for its Citizens, Visitors and City administration. The level of integration that is required to provide seamless operations across smart services are achieved through the centralized integration of the diverse smart services' devices with LCCC.

The LCCC employs a service integration platform which enables implementation of a common platform to manage the various processes, practices and approaches that characterize the diverse ICT systems.

The various smart service devices are interfaced with LCCC through Lusail Access Network. The basis on which the smart service devices communicate with the LCCC are defined and segregated into interfacing scenarios. The interfacing scenarios of smart devices are detailed below.

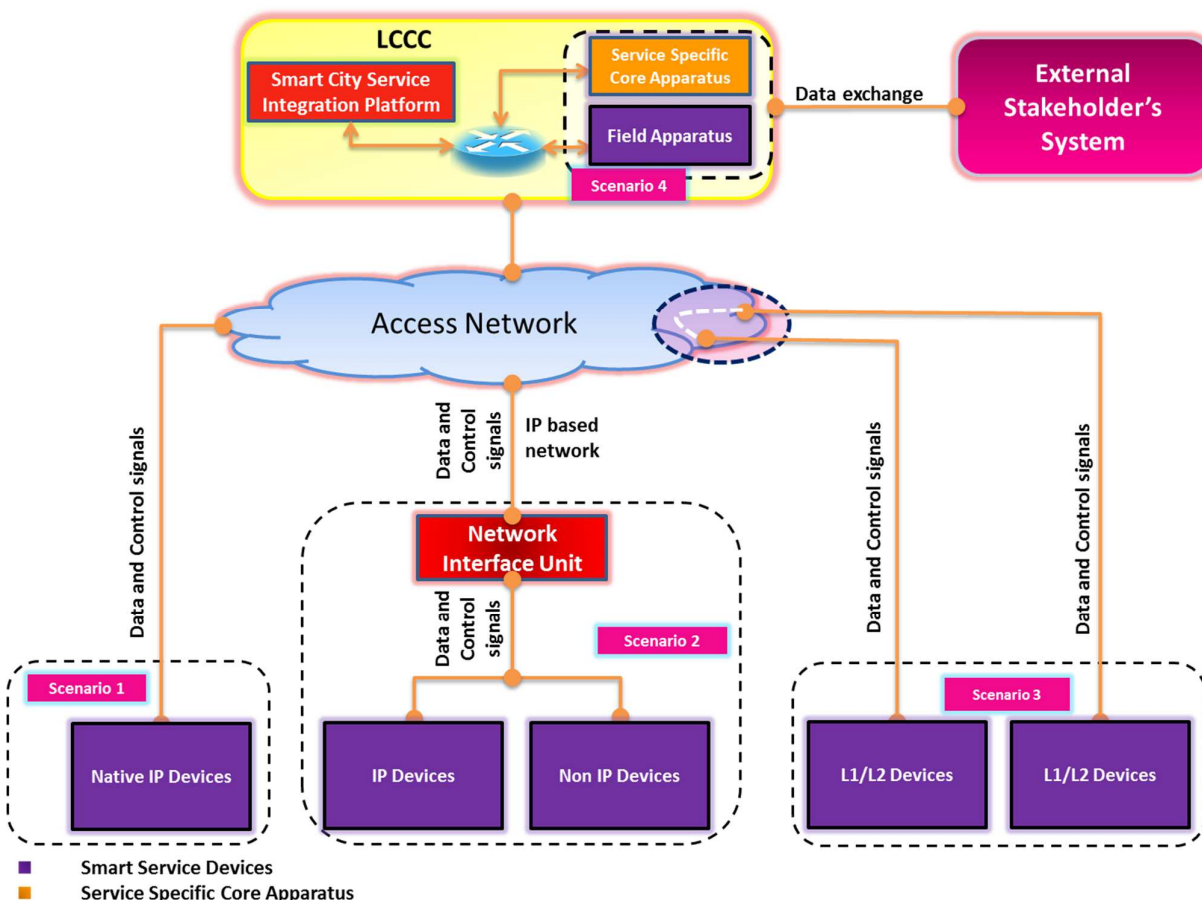


Figure 17 – Interfacing scenarios of Smart devices with LCCC

7.1.1. Scenario 1 : Native IP Devices

The scenario specifically deals with smart service devices which are Native IP devices. Smart devices within this scenario can be connected directly to the LCCC through the Lusail Access Network by a Fibre optic communication medium. The Fibre optic cable, part of the LAN, is a single mode Fibre optic cable fully compliant with ITU-T 652.D or G657.A2.

7.1.2. Scenario 2 : Network Interface Unit (NIU)

The smart service devices communicate with a Network Interface Unit (NIU) within this scenario. The network interface unit enables communication between devices that use different protocols by supplying / translating to a common transmission protocol, which is used instead of the devices own protocols. The network interface unit in turn is connected to the LCCC through the Lusail Access Network by a Fibre optic communication medium. The Fibre optic cable, part of the LAN, is a single mode Fibre optic cable fully compliant with ITU-T 652.D or G657.A2.

7.1.3. Scenario 3 : Layer 1 & Layer 2 Devices

The scenario specifically deals with smart service devices which require communication within devices in order to enable the associated smart services. The smart service devices communicate with each other accessing the Lusail Access Network by a Fibre optic communication medium. In this scenario, the smart devices are interconnected without being interfaced to the LCCC. The Fibre optic cable, part of the LAN, is a single mode Fibre optic cable fully compliant with ITU-T 652.D or G657.A2.

7.1.4. Scenario 4 : Smart Service Specific Core Apparatus

The scenario deals with smart service specific core apparatus or field apparatus which are required to be integrated within the LCCC (Lusail Command & Control Centre) itself. This level of integration is being done based on business requirements of the smart service. The interfacing is done via Fibre optic communication medium to the necessary LCCC components. The Fibre optic cable is a single mode Fibre optic cable fully compliant with ITU-T 652.D or G657.A2.

8 Design Approval Process

All development projects within Lusail Smart City are governed by the Lusail City Administrative Complex (CAC). It provides design consultants with the policies and procedures for the approval and execution of development projects in Lusail City.

All designers of project developments within Lusail Smart City are required to approach Smart City Service Provider, Ooredoo, to ensure the development is compatible and capable for Smart City Service provisioning.

This provides the occasion for designers to get advice on the Smart City Services that are being provided by the Smart City Service Provider, Ooredoo. The requirements of the building structure being developed in order to be compatible with Smart City Services provisioned will be provided.

The Building Permit Approval procedure for all developments within Lusail Smart City, being followed by Lusail City Administrative Complex is shown below.

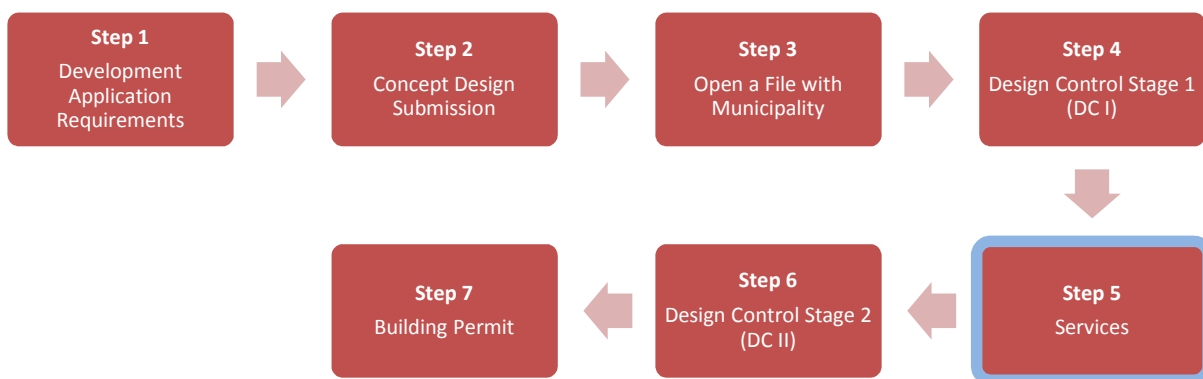


Figure 18 - Building Permit Approval process of Lusail City Administrative Complex (CAC)

Design consultants are required to approach Smart City Service Provider, Ooredoo, during the smart services design stage namely **“Step 5: Services”** of the building permit procedure of Lusail Smart City Administrative Complex.

It is mandatory that the design consultants get approval for the smart services design, in their project development within Lusail Smart City from Smart City Service Provider, Ooredoo.

9 Appendix 1: Sample Calculations (Actual Scenario may vary)

The purpose of this section is to illustrate for the building designer a sample calculation process for cable and ducts sizing for typical building examples. However, it is the responsibility of the building designer to design the ducts and cables based on the actual requirements of the structure being constructed.

This section follows the specifications and requirements mentioned in “Internal Wiring Guidelines” v6.0 document published by ICT Qatar on February 28th, 2013.

9.1. Example 1: Ten Floors Multi Dwelling Building

9.1.1. Example Details

Assume a multi dwelling building with the following components:

- Building is composed of 10 floors.
- In each floor there are 4 flat (Apartments/Shops/Offices).
- In each floor there are 6 service points.
- In each flat (apartment/shop) there are a total of 2 service points.

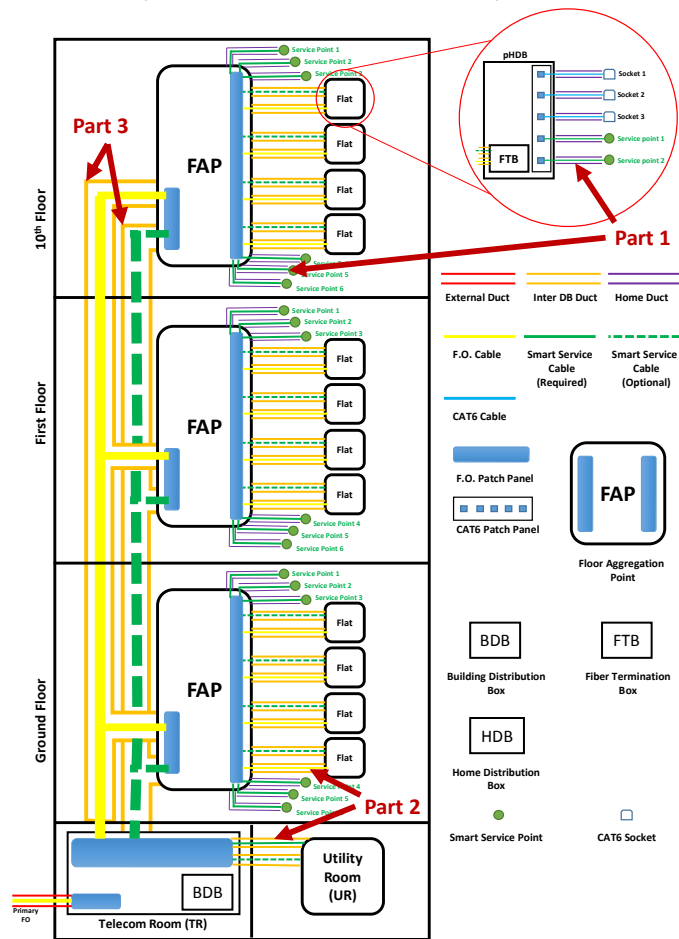


Figure 19 - Example 1: Ten Floor Multi Dwelling Building Illustration

9.1.2. Cables Calculations

- **Part 1: Service points cables calculations:**

This part is concerned with cable number and type for the cables that is used to connect service points. "Service Point" means any location within a Structure including Residential apartments, Villas, Offices, Institutions, Schools, Hotels, Hospitals, Shopping malls, Exhibition Centres, Convention Centres, Multipurpose Halls, Utility Buildings, Car parks where smart service may be required.

Service points are connected with smart service cable which could be either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint. Number and type of cable in this part will depend on the number of service points and type of physical port for the service point.

- **Part 2: Building cables (Inter-DB Cables) calculations:**

This type of cables are used to 1) connect flats (shops/apartments) to floor aggregation point (FAP) and 2) connect utility room (UR) to building telecom room (TR). The type of cables used are Low-Smoke, Zero-Halogen (LSZH) single mode F.O cables.

The parts of the building that these cables are going to be used in are:

- 1) To connect flats (shops/apartments) Fibre termination box to floor aggregation point (FAP) Fibre patch panels
 - Each flat is connected with 12F Fibre optic cable, the 12 fibres are allocated as 4F for telecom, 4F for smart services and 4F for maintenance and future expansion
- 2) To connect utility room (UR) Fibre patch panel to building telecom room (TR) Fibre patch panels.
 - Utility room (UR) is connected with 12F Fibre optic cable.

- **Part 3: Riser cables calculations:**

Riser cable is the main distribution cable in the building. The type of cable used for riser cable is Low-Smoke, Zero-Halogen (LSZH) single mode F.O cable. Moreover, the capacity of the riser cable shall equal the total number of fibres inside the building and maintenance capacity. Below are the steps for calculating the capacity of riser cable for Example 1:

- Total number of fibres per floor = (total number flats) x (Active Fibbers of F.O. cable connected to each flat)
 - Total number of fibres per floor = (4) x (8F) = 32F
- Total number of fibres required in the building = (total number of fibres per floor) x (number of floors inside the building)
 - Total number of fibres required in the building = (32F) x (10) = 320F
- Minimum size of riser cable = (total number of fibres required in the building) + (maintenance margin)
 - Maintenance margin = (25%) x (Total number of fibres required in the building) = (0.25) x (320F) = 80F
 - Minimum size of riser cable = (320F) + (80F) = 400F
 - Capacity of Riser cable will be 3 (144F) fiber optics cables.

9.1.3. Duct Calculations

- **Part 1: Service points ducts calculations:**

This part is concerned with duct size and type for the cables that used to connect service points.

Ducts used to connect service points are home ducts which is used provide physical support for cable elements and protects the cable from mechanical compression and abrasion stresses that occur during installation and operation of the smart services. Home ducting can also provide some protection to the UTP communication cable from induction effects of nearby or adjacent power supply cables.

- The percentage fill of any home ducting solution used to distribute cabling must not be more than 50% by volume at the design stage.
- To calculate the home duct size for smart service cables on each floor and inside flats (apartment/shop):
 - The home duct will have provision for both one 4F cable and 2 CAT6 cables
 - The CAT6 cable outer diameter = 5.842 mm
 - The 4F cable outer diameter = 7 mm
 - The minimum internal duct diameter required = $2*(5.842)+7 = 18.684$ mm
 - A duct with internal diameter greater than 20mm is required.
 - Duct with internal diameter of 25mm is recommended for installation.
- **Part 2: Building ducts (Inter-DB ducts) calculations:**

This type of ducts are used to 1) connect flats (shops/apartments) to floor aggregation point (FAP) and 2) connect utility room (UR) to building telecom room (TR). The type of ducts used are u-PVC (un-plasticized PVC) pipes. Other solutions like GI (Galvanized Iron) ducts or cable trays are also acceptable.

The parts of the building that these ducts are going to be used in are:

- 1) To connect flats (shops/apartments) Fibre termination box to floor aggregation point (FAP) Fibre patch panels and to connect utility room (UR) Fibre patch panel to building telecom room (TR) Fibre patch panels.
 - Each flat/Utility room is to be connected with 12F Fibre optic cable with outer diameter (OD) of 14 mm.
 - Future cabling provision to be maintained for 2 Cat6 Cables.
 - The CAT6 cable outer diameter = 5.842 mm
 - The minimum internal duct diameter required = $2*(5.842)+14 = 25.684$ mm
 - A duct with internal diameter greater than 26mm is required.
 - Duct with internal diameter of 32mm is recommended for installation.
 - Another duct with similar size need to be installed for future expansion

- **Part 3: Riser ducts calculations:**

Risers are required in multiple-storey buildings for the installation of telecom Fibre optic cables from main telecom room to other floors.

 - Galvanized slotted iron cable trays (minimum 200x50 mm HDRF (Heavy Duty, Return Flange) should be provided from the main telephone room, to each telephone closet and extended up to the roof telephone room
 - The risers to each floor must be symmetrical and vertically in line with the main telecom room.

- Where the main telecom room, floor telephone closet and roof telecom rooms are to be located one below the other in vertical line, a continuous cable trays/ conduits must be provided with pull boxes/access panels at every turning point and at interval of 30 meters each, up to the main telecom room. Right angle or sharp bends are to be avoided.
- Size of riser HDRF cable tray can be calculated as follows:
 - Capacity of riser cable will be 3 (144F) F.O. cable
 - Outer diameter of 1 (144F) F.O. cable = 17mm
 - Horizontal dimension of riser cables bundle = $3 \times 17\text{mm} = 51\text{mm}$
 - Riser cables will be placed as shown in Figure 1
 - Two riser HDRF cable trays will be placed, 1st cable tray will be used for the primary riser cable and 2nd cable tray will be used for secondary riser cable
- **Note:** minimum clearance of 3 m shall be maintained between walls of primary and secondary riser cables

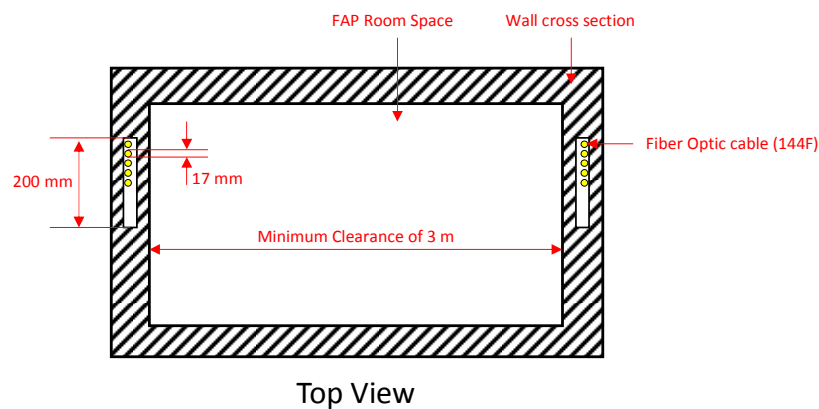


Figure 20 - Example 1: Floor Aggregation Point (FAP) room cross section (Top View)

9.2. Example 2: Single Dwelling (Two floor Villa) Building

9.2.1. Example Details

Assume a single dwelling (Villa) building with the following components:

- The villa is composed of 2 Floors
- In each floor there are 6 service points

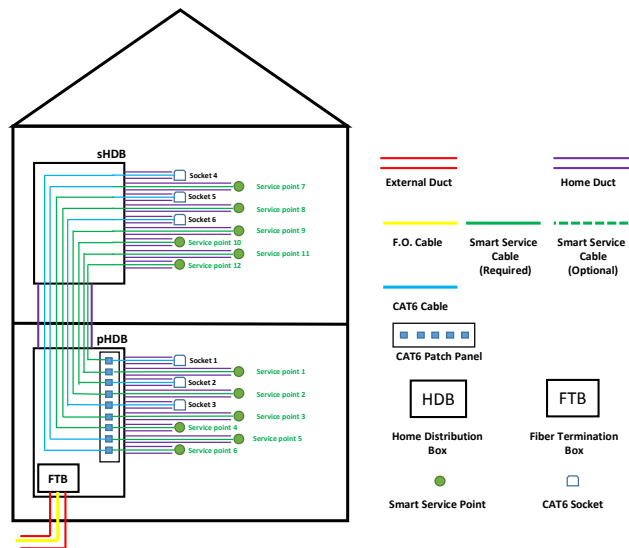


Figure 21 - Example 2: Single Dwelling (Two Floor Villa) Building

9.2.2. Cables Calculations

This part is concerned with cable number and type for the cables that is used to connect service points.

Service points are connected with smart service cable which could be either Fibre optic cable (4F/12F) or UTP (Cat 6) cable based on the distance and bandwidth requirements of the endpoint. Number and type of cable in this part will depend on the number of service points & type of physical port for the service point.

9.2.3. Duct Calculations

- The percentage fill of any home ducting solution used to distribute cabling must not be more than 50% by volume at the design stage.
- To calculate the home duct size for each smart service cables inside villa:
 - The home duct will have provision for both one 4F cable and 2 CAT6 cables
 - The CAT6 cable outer diameter = 5.842 mm
 - The 4F cable outer diameter = 7 mm
 - The minimum internal duct diameter required = $2 \times (5.842) + 7 = 18.684$ mm
 - A duct with internal diameter greater than 20mm is required.
 - Duct with internal diameter of 25mm is recommended for installation.